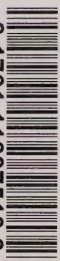


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CANADIAN INDUSTRY PROGRAM FOR ENERGY CONSERVATION



1987

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The Canadian Industry Program for Energy Conservation (CIPEC) is an industry-administered/government-sponsored program for promoting and monitoring energy efficiency throughout the Canadian manufacturing and mining industries.

CIPEC was established on May 23, 1975, as a result of deliberations between the Federal Government's Ministers of Energy, Mines and Resources, Trade and Commerce, and 50 of industry's most senior representatives. It now consists of 14 different industrial task forces that represent a broad spectrum of Canadian manufacturing and mining industries.

The program's objectives are to promote energy conservation by:

- Setting voluntary energy efficiency improvement goals.
- Reporting annually to government on issues and progress relative to achieving these goals.
- Increasing energy management awareness and techniques within industry.
- Exchanging non-proprietary energy information for common benefit.
- Maintaining effective industry-government dialogue.

Table of Contents

1987 Performance	1
Energy Consumption and Savings	3
Energy Use Trends	4
Natural Gas	5
Refined Petroleum Products	5
Electricity	5
Coal and Coke	6
Others	6
Factors Affecting Performance	6
Production Volume and Capacity Utilization	8
Energy Prices	8
Profits and Capital Investments	10
Ratio of Energy to Manufacturing Expenses	12
Reporting Population	12
Weather	13
Federal Government Activities	13

Task Force Reports

Chemical	15
Electrical and Electronic	19
Ferrous Metals	23
Food and Beverage	27
General Manufacturing	33
Industrial Minerals	39
Machinery	45
Mining and Metallurgy	49
Petroleum Refining	53
Plastics Processing	57
Pulp and Paper	61
Textiles	65
Transportation (Manufacturing)	69
Wood Products (Western)	73

Reporting Companies	77
---------------------------	----

Appendix A – Reporting Methodology	82
---	----

Appendix B – Conversion Factors	83
---------------------------------------	----

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CANADIAN
INDUSTRY PROGRAM
FOR ENERGY CONSERVATION

PROGRAMME CANADIEN
D'ÉCONOMIE D'ÉNERGIE
INDUSTRIELLE

August 12, 1988

The Honourable Marcel Masse, P.C., M.P.
Minister, Energy, Mines and Resources
House of Commons
Ottawa, Ontario
K1A 0A6



W. Peter Torbet

Dear Minister,

This 1987 Report of the Canadian Industry Program for Energy Conservation shows continued excellent progress towards meeting our 1990 composite goal. While I am pleased to tell you of this success, I am saddened to report the death of our Chairman, Mr. Jeffrey Skelton, in March of this year. Jeff's contribution to the program was considerable and his leadership and counsel will be sadly missed.

Overall, industry's energy use per unit of output for 1987 was 28.4% less than the base year of 1973 and 2.6% less than 1986. In general, those Task Forces that have done particularly well this year are the ones where the strong economy has stimulated their business and raised capacities to very high levels of operating efficiency. Some Task Forces have already achieved their 1990 goals.

Your presence at our April Council meeting was most welcome and we regarded it as a strong endorsement of the CIPEC program. Also, the opportunity for me to outline our success story at your Energy Options Conference was very timely in view of the growing importance of energy conservation. At the conference, I emphasized the need for more practical information, such as the series of booklets on energy management developed by your Ministry, as one of the means of overcoming some of the major barriers to enhanced energy conservation. I also stressed that continued Industry/Government co-operation is essential if we are to achieve greater levels of success in future.

Looking ahead, we should meet our 1990 goal of 31% provided the economy stays strong, but any additional new rates of efficiency improvement will require much stronger efforts. In particular, solid support and encouragement of research and development is required, together with greater use of the best technologies and equipment used by our international competitors. This is essential for us to set ambitious new performance goals for 1995.

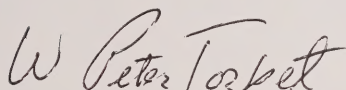
Governments have spent large sums of money on development of new energy supplies but comparatively little to help end-users achieve the levels of efficiency which are economically feasible. If we are to make faster progress, this imbalance must be corrected.

We further believe that Canada must not only develop all available sources of energy and use these sources wisely, but should also preserve the non-renewable resources as much as possible. This makes good sense for the people and future of Canada, and at the same time makes good economic sense to Canadian industry.

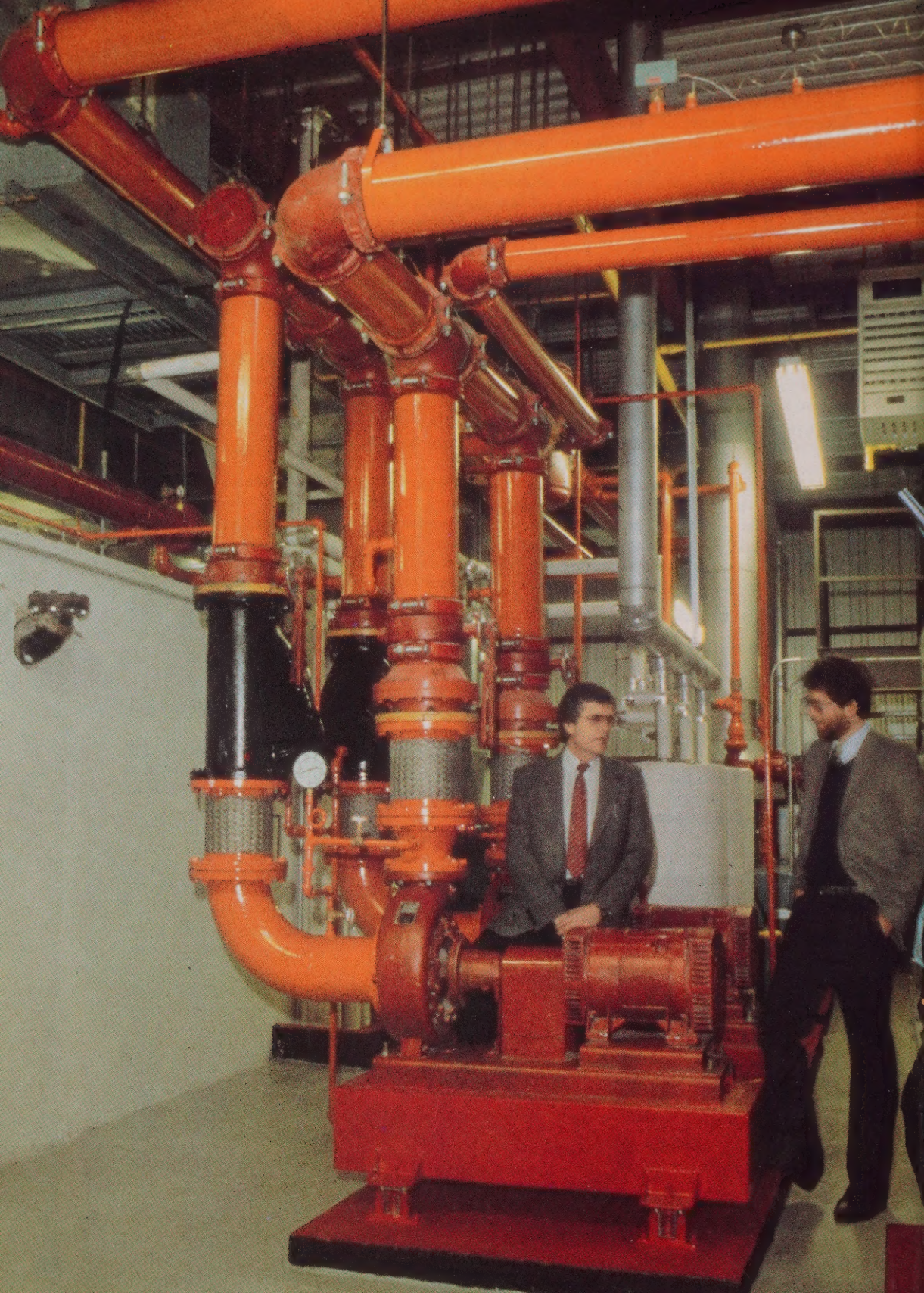
This inevitably brings up the issue of Free Trade with the United States. This is a matter which could have enormous impact on most industries. The nature and extent of that impact on energy use will differ in all Canadian industries. However, it is obvious that, while playing in a larger arena brings greater opportunities and challenges, the need for greater operating efficiencies becomes even more important for survival.

It is my pleasure as the new Chairman to pay tribute to the dedicated efforts of all those volunteers in the Task Forces, on the CIPEC Council, in the supporting Trade Associations, and especially, all the participating industrial companies that make this program such a notable success. As well, your staff in the Business and Government Energy Management Division deserve special recognition for their enthusiastic support. Without this co-operation, our achievements in this unique program would not be possible.

Yours sincerely,

A handwritten signature in dark ink, reading "W Peter Torbet". The signature is written in a cursive, flowing style with a large initial "W".

W.P. Torbet
Chairman, CIPEC Council



Energy at the Crossroads

1987 Performance

Canadian manufacturing and mining industries' energy efficiency improvement, as determined by a survey of 634 CIPEC participating companies, increased a buoyant 2.6% in 1987, raising the total increase to 28.4% over the original 1973 reference period. Compared with the new updated 1985 base year, efficiency has increased 4.3%. At this rate of increase, the 1990 goal of 31% should be achieved as planned.

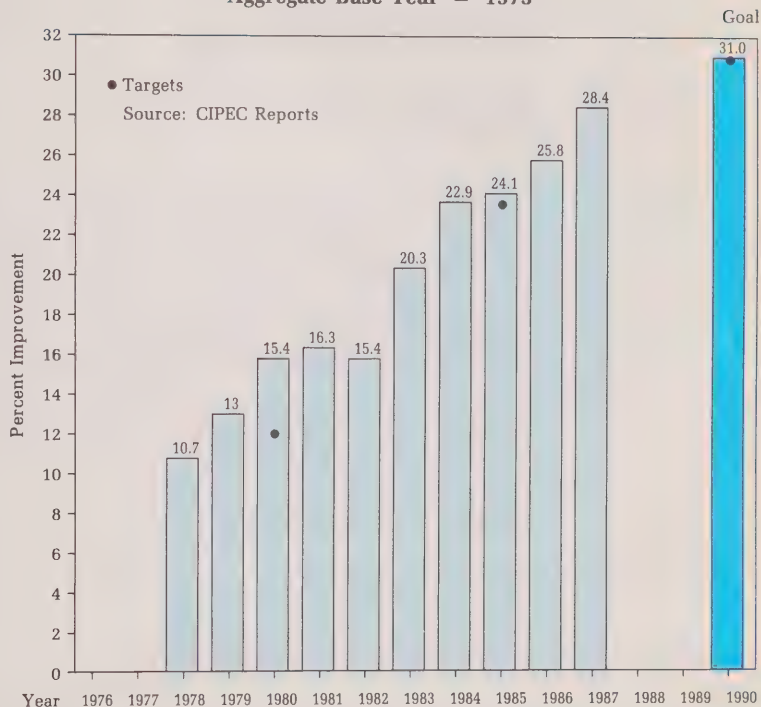
Improvement in energy utilization is the result of many interdependent factors. In 1987, the bulk of the gains resulted from:

- Higher production levels
- Higher capacity utilization
- Higher profits and capital investment in the past few years
- Warmer weather.

While lower fuel oil and natural gas prices reduced some of the incentives to conserve, costs are again on the rise. Together with steadily increasing electrical prices, the need to offset energy cost increases with energy efficiency gains has again become a priority. CIPEC's historical performance, shown in Figure 1, exhibits an average improvement rate of 1.8% per year. While this

Figure 1

CIPEC Energy Efficiency Aggregate Base Year = 1973



overall performance incorporates various structural and product changes that have occurred throughout the participating industries, the higher 1987 gain suggests that companies have benefited from exceptionally good operating conditions this year.

In Figure 2, the performance of each of the 14 sectors is displayed, together with their individual 1990 goals. It should be noted that each industry has vastly different energy intensities and potential for conservation; therefore, one should not be directly compared with another.

Figure 2

ENERGY INTENSITY IMPROVEMENT



Legend: ■ - Base Year to 1985
■ - Base Year to 1987
■ - 1990 Goal

Source: CIPEC Task Force Reports

Energy Consumption and Savings

The total amount of fuel and electricity used by the CIPEC participants in 1987 was 1451 petajoules, which is equivalent to the energy content of a 20-mile-long unit-train carrying crude oil delivered on a daily schedule, or, in electrical terms, equal to the output of 17 Ontario Hydro Bruce B nuclear stations delivering 3400 megawatts operating at 80% capacity.

This amount, supplied by the sources shown in Table I, represents about 61% of the 2395 petajoules of secondary¹ energy consumed by the total manufacturing and mining industries. Energy used as feedstocks is not included in the CIPEC survey since energy conservation was never intended to apply to these raw materials. Non-purchased waste hog fuel and pulping liquor used in the pulp and paper industry is also not included because of the difficulty of monitoring variable heat content and quantities used.

Table I

CIPEC Energy Consumption

Type	Quantity	Terajoules
Electricity	88,412,472 MWh	318,285
Natural Gas	12,882 million m ³	480,869
#2 Oil	274,713 kilolitres	10,885
#6 Oil	3,194,695 kilolitres	119,359
Propane	308,922 kilolitres	8,400
Diesel	249,988 kilolitres	9,974
Gasoline	15,957 kilolitres	577
Coal/Coke	6,403,467 tonnes	293,314
Steam	n/a	19,948
Others	n/a	189,969
Total		1,451,580

Source: Task Force Reports

¹ Secondary energy is defined as the end-use consumption after deductions are made for transmission losses, producers' own consumption

(e.g. fuel used to generate electricity), and use in the non-energy sector, e.g. raw materials and feedstocks.

Table II

Energy Consumption, Costs, and Savings

	Energy Use (TJ)	Estimated Total Cost (\$'000)	Accumulated Savings (\$'000)	Annualized Savings (\$'000)
Chemical ⁽¹⁾	250,170	1,133,898	741,832	32,021
Electrical and Electronic	6,690	47,172	55,823	2,231
Ferrous Metals	272,320	928,934	76,428	5,464
Food and Beverage	37,610	212,592	74,384	5,381
General Manufacturing	16,910	117,250	48,243	5,987
Industrial Minerals	91,260	433,702	161,351	10,289
Machinery	570	4,115	1,019	69
Mining and Metallurgy	133,150	782,248	109,638	6,929
Petroleum Refining ⁽¹⁾	267,000	590,839	259,289	12,263
Plastics Processing	2,090	16,439	10,718	982
Pulp and Paper	318,980	2,438,009	1,211,705	55,182
Textiles	9,280	62,885	22,789	1,313
Transportation (Manufacturing)	40,150	254,815	73,138	6,474
Wood Products (Western)	5,390	40,661	23,984	1,748
Total ⁽²⁾	1,451,580	7,063,562	2,870,344	146,338

⁽¹⁾ All sectors' electrical conversion factors, including the Chemical and Petroleum Refining totals, are based on the standard 3600 kJ/kWh rate.

⁽²⁾ Numbers may not add due to rounding.

Source: CIPEC Task Force Reports.

While industry remains the single largest consumer of energy, using 37.2% of the total 6213 petajoule secondary domestic demand, it uses less fuel oil than the transportation sector, residential and farming, and the commercial and institutional sectors.

The cost of fuel and electricity used during 1987 is estimated to be \$7.06 billion (Table II). The 2.6% energy efficiency improvement of 1987 over 1986 results in an additional \$146 million cost avoidance.

The total cost savings for 1987 over the original base year is \$2.87 billion (28.4% improvement). The estimated cumulative savings for the program now totals \$19 billion.

Energy Use Trends

CIPEC continues to monitor the energy consumption trends of its participants to determine where conservation actions are taking place and what forces are motivating changes.

Availability and price continue to be the major forces affecting energy shares. For example, the large shift to cheap coal in the Industrial Minerals sector and extension of the natural gas pipelines into Quebec helped that province's machinery and textiles companies make a dramatic shift away from unpredictably priced fuel oil. As well, the successful marketing of Quebec's low cost electricity also helped industries switch to electric-powered steam boilers.

Figure 3 shows that the changes in the sources of energy over time have mostly been in the reduction

of fuel oil. Furthermore, Table III shows that not all sectors have substituted at the same rate because of the nature of their operations and/or access to alternatives.

CIPEC's reported energy consumption and end-uses are somewhat different from Statistics Canada's mainly because of differences in participation and inclusion of "other" fuels in the CIPEC survey.

Other differences arise from the fact that CIPEC companies tend to be the largest in their industries. Thus CIPEC shows greater use of waste fuels, coal and coke, and smaller shares of electricity than the broad mix of companies included in the Statistics Canada database.

CIPEC companies would therefore tend to have lower average energy costs and longer economic returns on energy conservation investments compared with industry as a whole.

Table III

Distribution of Energy Consumption (percentage)

	Nat. Gas and Propane					Liquid Petroleum Products					Electricity ⁽¹⁾					Coal and Coke					Others ⁽²⁾				
	87	86	85	80	75	87	86	85	80	75	87	86	85	80	75	87	86	85	80	75	87	86	85	80	75
Chemicals	50.1	48.6	51.2	54.4	57.1	2.1	3.0	4.3	14.1	24.3	32.0	31.0	27.9	24.2	17.3	0.6	0.5	0.1	2.3	-	15.2	16.9	16.5	5.0	1.3
Electrical	56.0	57.6	63.6	57.3	48.0	2.2	3.6	1.4	9.6	24.4	41.1	37.5	33.5	31.5	27.8	-	-	-	-	-	0.7	1.3	1.5	-	0.2
Ferrous Metals	19.6	19.7	19.4	18.9	15.4	5.1	4.6	4.2	10.5	13.2	7.6	7.6	7.3	5.9	5.4	67.7	68.1	69.1	64.6	68.6	-	-	-	-	0.3
Food and Bev.	69.2	69.5	69.7	64.8	48.5	9.9	10.8	11.7	20.6	38.5	20.8	19.4	18.6	14.6	12.8	-	-	-	-	-	0.1	0.3	-	-	0.2
General Mfg.	52.0	53.9	60.2	52.9	n/a	10.1	10.4	11.6	21.0	n/a	37.6	35.3	28.1	26.1	n/a	-	-	-	-	-	0.3	0.4	0.1	-	n/a
Ind. Minerals	42.7	40.1	42.6	43.1	50.6	6.6	6.9	8.7	26.1	33.1	15.5	15.7	15.6	15.8	10.3	34.0	36.6	32.4	14.3	5.8	1.2	0.7	0.7	0.1	0.1
Machinery	55.3	57.6	54.1	41.1	22.1	6.7	6.5	8.5	30.3	51.4	38.0	35.9	37.4	24.7	23.6	-	-	-	-	-	-	-	-	1.3	-
Mining	19.0	23.5	25.2	18.6	12.4	15.9	24.3	23.5	36.5	48.0	34.2	40.2	41.2	39.5	35.1	8.4	11.9	9.9	4.5	4.4	22.5	0.2	0.2	0.5	-
Petroleum	18.7	19.3	24.3	12.9	12.5	4.1	9.8	6.7	23.7	22.9	13.3	5.5	4.6	3.6	3.5	19.8	20.7	19.6	15.1	16.7	44.1	44.7	44.7	44.7	44.4
Plastics Proc.	47.6	53.4	51.4	63.5	43.5	2.9	4.2	5.4	3.1	31.9	49.5	42.5	43.2	33.4	23.7	-	-	-	-	-	-	-	-	-	-
Pulp & Paper	27.0	26.1	26.1	25.5	18.3	23.1	24.0	25.8	41.3	52.7	47.9	47.5	44.9	29.1	24.9	1.5	1.9	2.9	3.0	3.6	0.5	0.5	0.3	1.0	0.7
Textiles	55.4	55.1	55.0	27.2	29.1	8.1	8.1	15.8	49.1	49.9	36.6	36.6	29.1	22.0	20.1	-	-	-	-	-	0.3	0.2	0.1	1.7	0.9
Transport (Mfg.)	57.0	56.2	55.2	49.5	42.1	2.5	3.5	3.7	16.2	31.0	32.8	30.7	30.1	23.6	23.0	7.7	9.5	11.0	11.1	3.1	-	0.2	0.6	-	0.4
Wood Products	47.4	44.0	52.0	45.3	n/a	-	-	-	11.1	n/a	52.6	56.0	48.0	43.6	n/a	-	-	-	-	-	-	-	-	-	-
Totals	33.7	33.6	32.3	31.0	27.9	9.7	11.6	17.6	24.3	32.0	21.9	22.1	19.1	18.5	14.6	20.2	20.9	19.2	17.1	17.8	14.5	11.8	11.8	9.1	7.7

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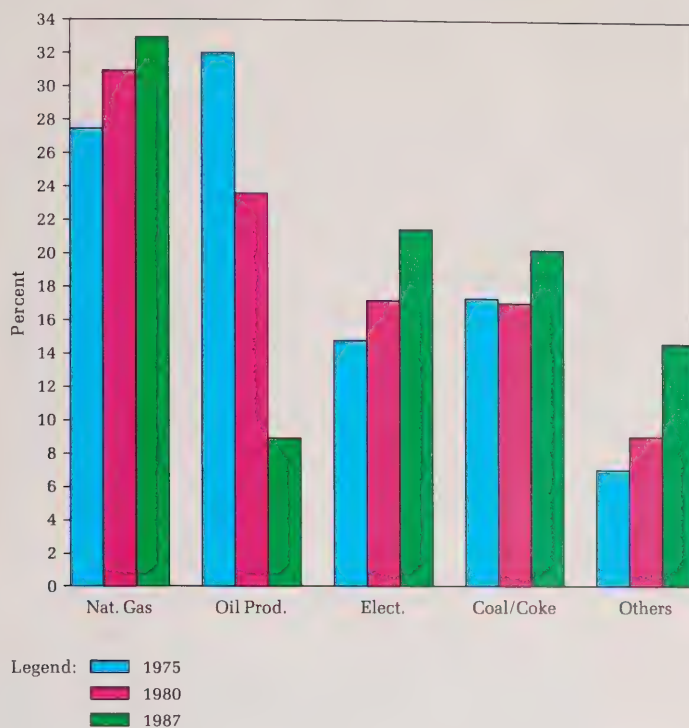
(1) All sectors' electricity converted at 3600 kJ/kWh.

(2) Other fuels include purchased steam, plant wastes, process by-products, miscellaneous fuels, but excludes wood wastes used in the Pulp and Paper and Wood Products sectors.

Source: CIPEC Task Force Reports.

Figure 3

CIPEC Distribution of Energy



Source: CIPEC Task Force Reports

Natural Gas

The CIPEC participants' trend toward greater use of natural gas came to a stand-still in 1987 at a market share of 33.7%.

In the five years prior to the introduction of deregulation in late 1985, CIPEC surveys showed a slow upward but steady 0.26% per year shift to natural gas. The quantity involved was equivalent to some 58,000 barrels of heavy oil per year.

In 1986 its market share spurted ahead 1.3% following moves to take advantage of the cheaper gas. It then held steady in 1987 when other fuels regained their competitive position.

Refined Petroleum Products

Consumption of fuel oil continues to decline at the steady rate of 2% per year. Since the beginning of CIPEC monitoring, the share of fuel oil has dropped from 32% to 9.7%. This means CIPEC participants now consume 52.9 million barrels per year less than they did in 1975.

The Ferrous Metal sector's minor increase is the result of a greater use of scrap (lower net production of raw steel) causing a percentage decline in the use of coke.

Even though there was no national or CIPEC goal set for reduction of oil consumption, the remaining 9.7% market share is thought to be very close to the practical bottom limit. Lower natural gas prices, the

extension of the natural gas pipelines into Quebec, and assistance from the Federal Government's Oil Substitution Program (now ended), motivated industry to switch to the more abundant natural gas fuel.

But many manufacturing companies still depend on fuel oil when there is no economic or supply alternative and for backup fuel. The possibility of co-combustion, i.e., fuel oil and coal, might slightly reduce oil consumption in eastern provinces where there are cheap indigenous coal supplies.

Electricity

The general shift towards greater consumption of electricity continues in all industries. Had it not been for the introduction of a huge tar sands plant into the reporting population in the Mining sector, the CIPEC electricity trend would have shown an increase again this year.

Previous increases in reported electrical consumption were due in part to Hydro-Quebec's very successful program for conversion of steam boilers from fuel oil to electric power. Quebec offered these incentives because of their large electric generating capacity and lack of indigenous fossil fuel. Pulp and Paper companies benefited most from this provincial program. Their consolidated electrical share rose from 24.9% in 1975 to 47.9% in 1987. As the result of similar incentives, the Textile industry's share increased from 20.1% to 36.6% for the same reason.

It is expected that total electrical consumption will increase about 2% to 3% per year because of a trend toward the greater electrification of factories and processes. For example, more extensive use of thermo-mechanical pulping (TMP), microwave drying systems, induction heating, etc., will continue to offer attractive technological and financial benefits.

Coal and Coke

The use of coal and coke in recent years has been limited because of its high environmental clean-up and transportation costs. Coal is used primarily in Ontario for electricity generation and in industries that manufacture steel and cement. The large quantity of coke used in the Petroleum Refining sector is actually a by-product that happens to be a cheap and ready source of fuel in that industry.

The Cement Manufacturing sector has been able to profitably increase its use, however, but even now this consumption is in decline because of price competition from natural gas.

A recent study² on the possible increased use of low-sulphur western Canadian coal identifies a number of major economic and environmental benefits that would help electrical generators (and industry) lower their manufacturing costs.

Others

The "other" category of fuels includes a diverse mix of wastes, process by-products, and miscellaneous fuels used mainly by the Chemical and Petroleum Refining industries. The huge amount of hog-fuel and pulping liquor used as fuel in the Pulp and Paper industry, as well as large quantities of hog-fuel used in the Wood Products industry, are not included in this category because of the difficulties of measuring heat content and quantities.

Occasionally, the use of these "wastes" change when their resale value exceeds their fuel value. Increased sale of by-product hydrogen is a recent example of this phenomenon.

Even though many of these fuels are treated as cost-free sources of energy, industry has not taken full advantage of them. Technological problems associated with materials

handling and combustion, as well as unpredictable supplies, have limited investment in many of these energy conservation opportunities.

Factors Affecting Performance

Industrial energy efficiency is affected by a number of distinct factors that can be classified to rank their impact on performance. Figure 4 shows the common factors most often identified in CIPEC task force reports.

primary side are considered the foundation of energy conservation programs and represent the easiest actions to accomplish. When one hears "the easiest savings have been done" it usually infers that secondary factors are taking priority.

Figure 4

Factors Affecting Energy Conservation	
	Primary Secondary
Direct	<div>conservation projects retrofits housekeeping actions maintenance</div> <div>process changes new technologies product changes corporate strategies operating procedures</div>
Indirect	<div>capacity utilization weather investment</div> <div>energy prices government policies and programs tax regulations R&D information business competition</div>

All the identified factors were initially grouped according to their direct/indirect and primary/secondary impact on results with subsequent consideration given to the effects of time, degree of management control over each factor, technological complexities involved, associated capital risks, and the influence of various incentives and market forces.

Direct factors have the most immediate long-lasting impact while indirect factors often have an uncertain and variable influence. Secondary factors represent more technologically complex and expensive action. Actions on the right side require more informed management attention than those simple primary items.

The resulting layout thus lends itself to several pertinent observations. For example, factors on the

It is also evident that all the motivating factors are concentrated in the bottom right (secondary/indirect) corner. These are the driving

² Report of a Federal/Provincial Task Force, "Western Canadian Low-Sulphur Coal", June 1986.

forces that initiate virtually all of the resulting actions. For example, R&D can lead to new technologies or process changes that result in retrofits to lessen the consumption and cost of energy.

In the early stages of CIPEC in the middle 1970's, strong motivational forces, i.e., rapidly rising energy prices, supportive government programs, favourable tax regulations (Class 34), etc., produced industrial efficiency gains of 2.5% per year.

In 1987, however, while most of the supporting motive forces were weak, the market-force (business competition) factor was the principal incentive contributing to energy efficiency improvement. But market-force actions have long-term effects and by themselves would not fully support the relatively high performance (2.6%) that occurred in 1987. It is therefore concluded that the bulk of the 1987 performance results came from primary/indirect causes, e.g., capacity utilization effects.

Industry's perception of energy conservation potentials, especially in view of current low oil prices, is another important motivating factor that can impact on performance.

Many studies have been done to analyze the causal factors affecting energy efficiency. For example, the American Gas Association³ recently found three-quarters of U.S. industry's energy efficiency improvements came from primary factors while the remaining one-quarter was due to secondary factors. (In this study, many of the process changes and new technologies were classified as primary factors).

While the annual CIPEC-monitored results show the combined effects of all factors, some of the task forces, e.g., the Chemicals group, have attempted to identify the vari-

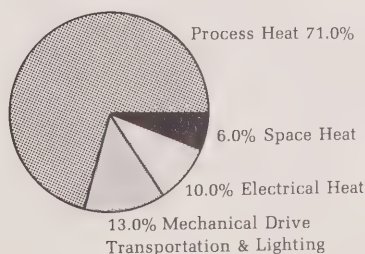
ous reasons for improvements in their industry. The results are somewhat inconclusive however, because of the limited number of participants and large diversity of technologies and operations.

Other sources of information pointing to the individual ingredients contributing to energy efficiency come from the results of provincial auditing programs. In Ontario for example, over 33% of the recommendations involve process improvements. This is not surprising in view of the end-use of energy in Canadian industry, as shown in Figure 5. However, industry management is still very reluctant to tamper with their processes but seem more responsive to improvements in plant utility systems. In this area, the Ontario program auditors find 31.6% of their recommendations identify ways to use light oil more efficiently, 16.4% apply to the use of natural gas, 7.5% relate to electricity improvements and 7.4% of the suggestions deal with the use of heavy fuel oil. Improvement of combustion systems therefore still have the highest priority.

Also, in a recent study⁴ done by EMR to examine the effects of low oil prices on energy conservation programs, it found the vast majority of projects using existing improvement technologies still provide acceptable economic paybacks of less than three years.

Figure 5

Industrial Sector Energy End-Use



Source: Energy, Mines and Resources

Of 1,120 common industrial energy conservation retrofit projects based on current energy costs, those involving reduction of heavy fuel oil consumption were economically acceptable 90% of the time. Many of these projects cost less than \$5,000.

Improvement projects involving natural gas were feasible 89% of the time.

Projects involving improved use of light fuel oil had an 80% chance of meeting the three-year payback criteria.

Common electrical retrofit projects also have a high "acceptability ratio" three-quarters of the time. This would suggest that, even though electrical prices are higher, the greater complexity and capital costs mean that improvements in this area will be more difficult to achieve. For this reason, the task facing Ontario Hydro in reducing the demand for its power will require strong supporting motivational factors, e.g., aggressive promotions, audits, grants, R&D, dissemination of information, etc.

Industry's perception of the necessity of conservation is also subtly affected by government's apparent emphasis on support of development of new supplies. Compared with expensive developments such as Hibernia and frontier resources at more than \$22 per barrel, and the costs of construction and lifetime operation of new nuclear generating and fossil fuel stations at some \$21 per barrel-equivalent, the "new resources" made available through conservation is still the most economic least-cost alternative. Energy conservation projects often cost less than \$8 per barrel-equivalent to implement.

³ American Gas Association, "Energy Analysis", Arlington, Virginia, January 22, 1988.

⁴ "The Economics of Energy Conservation at Low World Oil Prices", Energy Policy and Coordination (PAC) Division, Energy Conservation Branch, EMR, June 1987.

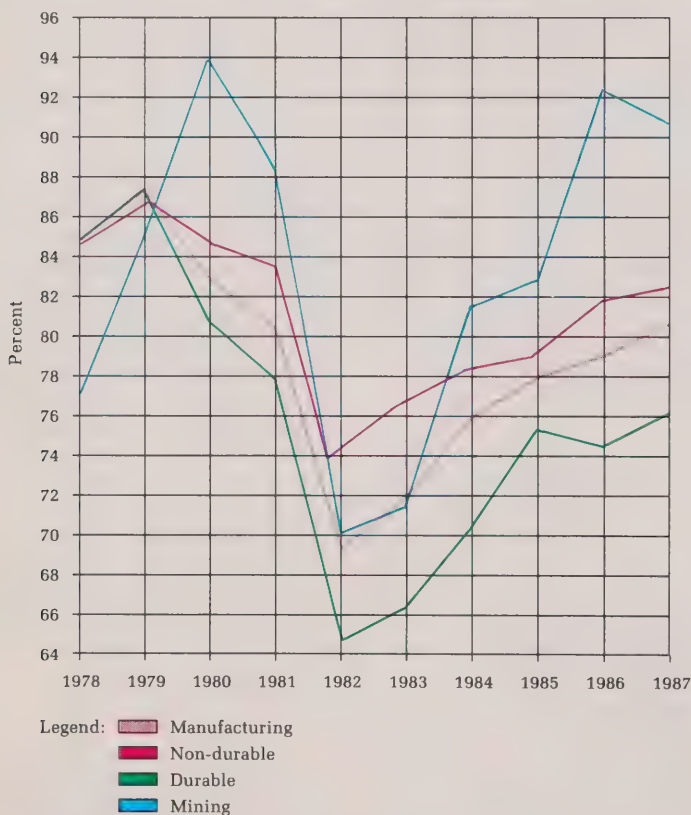
Production Volume and Capacity Utilization

High production and capacity utilization levels were the only primary factors during 1987 that helped performance. As well, while many of the secondary factors were weak, those that did contribute to energy efficiency were the result of general productivity and expansion programs.

Capacity utilization levels (Figure 6) have varying effects on energy efficiency because most equipment and factories are designed to operate best at about three-quarters of their maximum capacity. This phenomenon was very noticeable in 1982 when production volumes slumped (Figure 7) and the efficiencies of energy use were consequently dragged down.

Figure 6

Industrial Capacity Utilization



Source: CANSIM - Statistics Canada Cat. 31-003

In 1987, many companies reported factory production at or above 100% of "name-plate" capacities. In these situations, the need to meet production schedules overrode the desire to operate the plants in the most efficient manner. Many companies also reported extensive debottlenecking activities to raise capacities even higher. A few mothballed plants were brought back into production to satisfy demand.

Since companies and industries usually find it necessary to expand when capacity utilizations exceed the 90% level, it appears several sectors are well into an expansion phase. The new and more efficient equipment now being installed will contribute to future efficiency gains.

Analysis of the effect capacity utilization has on individual plants

becomes complicated when extended to total industry. One reason is that measurement of industrial capacity is done by different agencies that use different bases of comparison.

According to Statistics Canada, the Manufacturing Industry's capacity utilization rose 1.2% during 1987 up to the 80.3% level (Table IV). However, the Mining industry's trend declined 1.5% to 90.7% because of large investment in new facilities and equipment.

The annual impact of capacity utilization on energy efficiency is sometimes clearer when individual sector trends are examined. For example, the Electrical products sector energy efficiency gained 16 percentage points at the same time capacity utilization rose 7.6 points, while Transportation Manufacturing's efficiency dropped 5.4 points when capacity utilization went down 10 points during the year.

In addition, non-durable goods industries, e.g., Food and Beverage, Petroleum Refining, etc., have always displayed steadier capacity and efficiency patterns because of their low sensitivity to cyclical markets and hence their ability to operate at higher utilization rates. In contrast, durable goods industries, e.g., Electrical and Electronic and Wood Products, experience more volatile swings in capacity utilization and hence larger variations in energy efficiency.

Energy Prices

Perhaps the most important single factor impacting on performance is the effect of rising energy prices. Representative unit costs for each sector are shown in Table V.

The composite energy price, shown at the bottom of Table VI, resumed its upward direction again in 1987 after a brief dip in 1986. Electricity continues to be the highest priced source of energy.

Table V

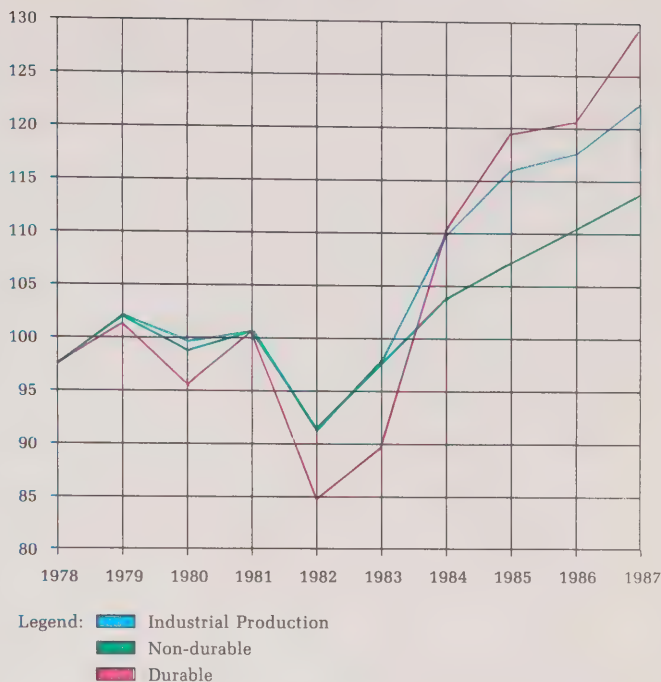
Sector Average Energy Unit Costs

Sector	\$/GJ
Chemical	4.53
Electrical and Electronic	7.05
Ferrous Metals	3.41
Food and Beverage	5.65
General Manufacturing	6.93
Industrial Minerals	4.75
Machinery	7.27
Mining and Metallurgy	7.49
Petroleum Refining	2.21
Plastics Processing	7.84
Pulp and Paper	7.64
Textiles	6.77
Transportation (Mfg.)	6.35
Wood Products (Western)	7.55
CIPEC average	4.87

Source: CIPEC Task Force Reports.

Figure 7

Industrial Production Index (1981 = 100)



Source: CANSIM - Statistics Canada Cat. 61-005

Unit costs vary among the provinces due to the methods of generation, fuels used, provincial taxes, and transmission costs. These factors not only result in the different average costs as shown, but also in different prices for the demand and energy components.

For example, large process type consumers (with high load and power factors) in each province would see an approximate demand to energy cost ratio of: 1/4.4 in Quebec, 1/3.8 Nova Scotia, 1/2.75 British Columbia, 1/2.2 New Brunswick, 1/1.9 Manitoba, 1/1.9 Saskatchewan, 1/1.6 Ontario, 1/1.4 Newfoundland, and 1/0.9 in Alberta.

Energy prices resumed their upward trend in 1987 after a minor decline resulting from the benefits of natural gas deregulation. This means the energy cost versus manufacturing expense ratio has resumed its upward trend and companies are again working harder to offset the increasing costs with improved operating efficiencies.

Table IV

Capacity Utilizations

Sector	1985	1986	1987
Chemical	70.9	70.4	71.9
Electrical and Electronic	84.8	85.2	92.8
Ferrous Metals	72.1	69.9	74.2
Food and Beverage	81.1	80.6	78.4
General Manufacturing	61.1	62.2	61.2
Industrial Minerals	84.9	78.9	74.0
Machinery	68.6	73.7	80.3
Mining and Metallurgy	60.3	59.5	59.0
Petroleum Refining	82.7	92.2	90.7
Plastics Processing	74.0	75.3	78.3
Pulp and Paper	92.7	93.0	94.9
Textiles	85.4	89.4	91.7
Transportation (Manufacturing)	87.1	89.8	96.2
Wood Products (Western)	78.6	72.6	62.6
Durable Goods Industries	85.6	82.7	90.9
Non-Durable Goods Industries	75.5	74.6	76.1
Total Manufacturing Industries	80.8	84.0	84.8
	78.0	79.1	80.3

Source: CANSIM - Statistics Canada Cat. 31-003

Table VI

Average Industrial Energy Prices
(Current \$/GJ)

		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Nfld.	Elect. ¹	6.50	7.80	8.19	9.11	10.94	11.58	12.05	15.58	15.72	14.05
	Oil ²	3.41	3.84	4.69	6.74	8.13	9.00	9.59	10.41	8.97	8.33
P.E.I.	Elect.	11.98	13.97	15.80	21.78	26.30	26.19	28.39	29.89	21.05	15.89
	Oil	3.41	3.84	4.64	6.56	7.95	8.64	9.23	9.92	8.49	8.28
N.S.	Elect.	7.78	8.89	9.33	9.33	9.33	11.56	12.03	12.03	13.00	13.31
	Oil	3.23	3.62	4.38	6.28	7.74	8.59	9.05	9.82	8.08	7.31
N.B.	Elect.	6.19	7.61	8.64	9.42	9.72	10.33	10.58	11.64	11.78	11.78
	Oil	3.26	3.67	4.36	6.31	7.74	8.59	9.21	9.95	8.79	8.46
Que.	Elect.	4.31	5.19	6.28	7.06	7.86	8.44	8.25	7.89	8.56	8.67
	Nat. Gas	2.15	2.28	2.63	3.32	4.33	4.63	4.96	4.63	4.65	4.58
	Oil	3.23	3.69	4.44	6.36	7.79	8.59	9.21	9.77	7.36	6.82
Ont.	Elect.	5.78	6.33	6.81	7.50	8.33	8.92	9.78	10.69	11.47	11.75
	Nat. Gas	1.94	2.10	2.41	3.07	3.80	4.25	4.25	4.22	4.10	3.75
	Oil	3.23	3.59	4.31	6.23	7.62	8.41	8.97	9.82	8.21	7.92
Man.	Elect.	4.69	5.53	5.58	5.58	5.67	6.06	6.56	6.92	7.00	7.69
	Nat. Gas	1.72	1.85	2.21	2.76	3.41	3.59	3.61	3.56	3.44	3.19
	Oil	3.10	3.49	4.28	6.23	7.54	8.56	9.10	9.87	8.92	7.97
Sask.	Elect.	6.19	6.86	7.64	8.36	9.58	10.39	11.92	12.53	13.33	14.31
	Nat. Gas	1.34	1.56	1.67	2.24	2.84	3.06	3.11	3.09	3.09	2.67
	Oil	3.13	3.49	4.26	6.21	7.59	8.33	8.90	9.64	7.72	7.44
Alta.	Elect.	3.97	4.86	5.28	6.14	6.83	7.92	9.00	8.89	8.81	8.81
	Nat. Gas	0.97	0.97	1.33	1.88	1.92	2.12	2.03	2.09	2.08	2.10
	Oil	—	—	—	—	—	—	—	—	—	—
B.C.	Elect.	3.42	3.75	4.50	5.56	6.86	7.61	8.31	8.61	8.75	8.75
	Nat. Gas	1.26	1.48	1.60	2.35	3.22	3.25	3.42	3.45	3.24	2.28
	Oil	3.28	3.67	4.36	6.28	7.64	8.44	8.92	9.69	8.10	7.51
CAN.	Elect.	4.83	5.58	6.36	7.17	8.14	8.83	9.31	9.69	10.17	10.28
	Nat. Gas	1.53	1.64	1.95	2.58	3.06	3.37	3.38	3.37	3.28	3.05
	Oil	3.21	3.62	4.38	6.31	7.72	8.54	9.10	9.82	7.92	7.46
Composite Price		2.70	2.96	3.44	4.47	5.36	5.77	6.09	6.43	5.97	6.13

¹ Monthly consumption 3,100 MWh (taxes included)² Distillate Fuel Oil

Source: Energy, Mines & Resources Statistics Handbook

Profits and Capital Investments

The strong relationship between industry after-tax profit levels and CIPEC performance is shown in Figure 8. Based on the historical trends, future performance looks good.

In spite of the high level of profits in the past three years, operating budgets remain tight, but capital budgets have grown. General investment paybacks must be less than 3 years. The pattern of capital invest-

ment for the past five years is shown in Figure 9. The average payback of energy-related opportunities however, is 1.9 years, according to one major provincial auditing program impact report.

Where stand-alone retrofits were implemented, they were usually at locations of high-grade energy conversion, e.g., burners, heat exchangers, etc.

Industry has not yet exhausted the low-cost opportunities for energy savings. Provincial auditing programs are finding potential energy savings of 22% of total consumption with economic payback less than 3 years.

Figure 8

Manufacturing and Mining Profits (after tax) With CIPEC Performance

Legend:
 Manufacturing
 Mining
 CIPEC Performance

Source: Statistics Canada Cat. 13-001, CIPEC Report

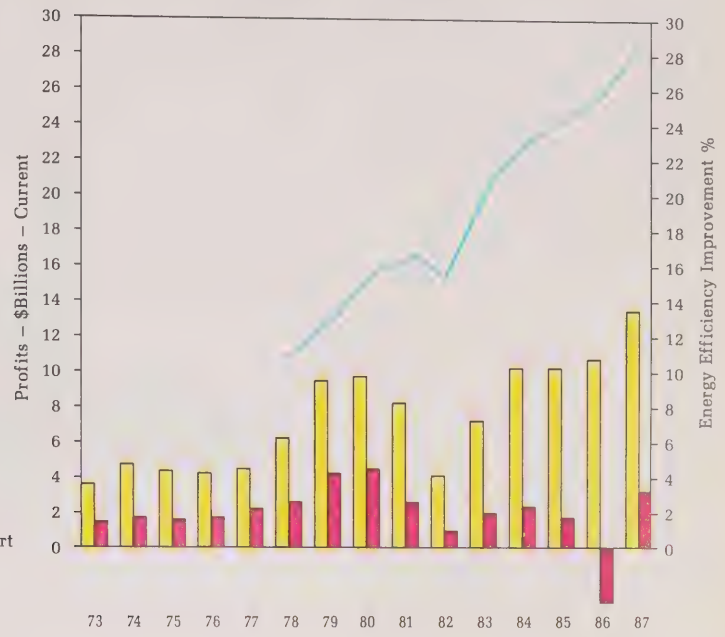
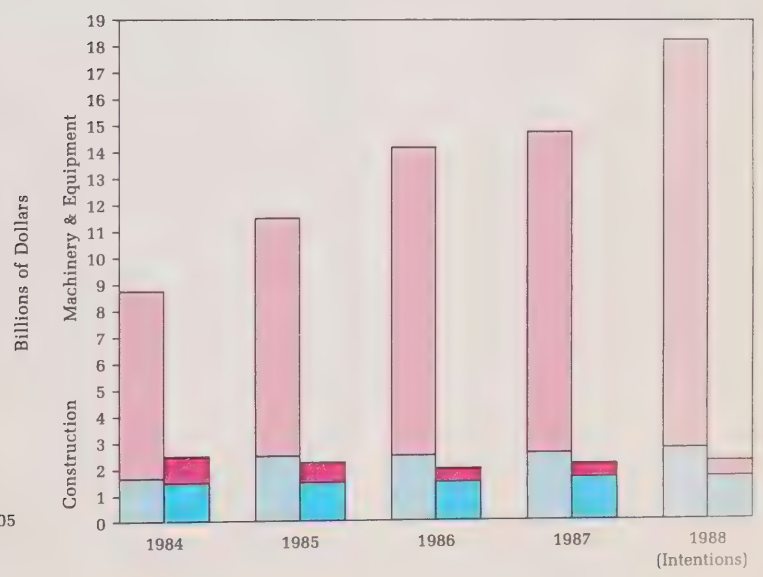


Figure 9

Capital Expenditures

Legend:
 Manufacturing
 Mining

Source: CANSIM - Statistics Canada Cat. 61-205



Ratio of Energy to Manufacturing Expenses

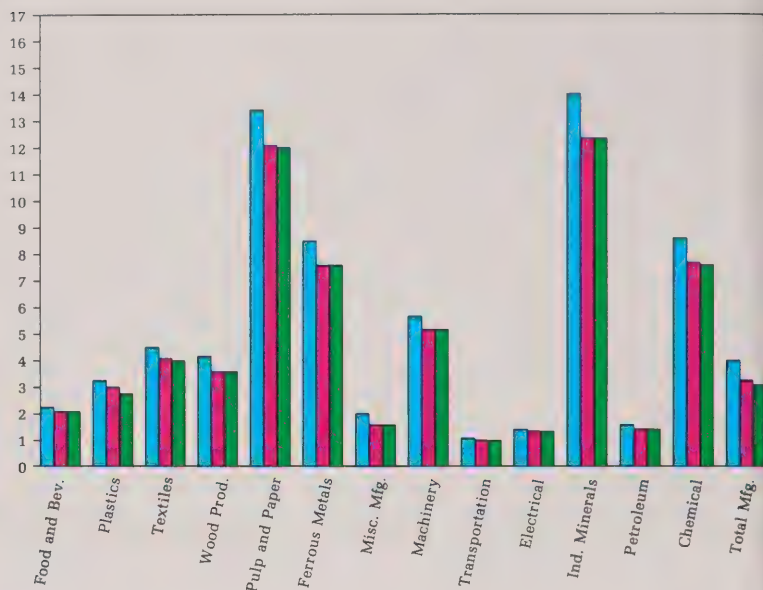
The energy cost versus manufacturing expense ratio is an important indicator of how well corporate energy management programs are operating. While this ratio varies in individual firms depending on local prices and mix of energy, the general industry trends shown in Figure 10 indicate that ratios have improved in the last three years because of reduced natural gas and oil prices.

Figure 10

Energy Cost vs. Manufacturing Expense

Percent

Legend: 1985
1986
1987 Est.



Source: CANSIM - Statistics Canada

Reporting Population

Six hundred and thirty-four companies, with a combined total of some 1,000 different plants, submitted data for performance evaluation this year, representing 61% of Canadian industrial secondary energy consumption. This level of participation compares with 653 in 1986, 678 in 1985, 693 in 1984, 704 in 1983, 663 in 1982, and 683 in the pre-recession year of 1981.

The normal reporting turnover rate is a low 5%, indicating the high general commitment to the CIPEC program. This constant turnover rate depresses the real efficiency gains somewhat because new entries do not have the history nor the same

level of savings comparable to those reported by regularly participating firms. Also, there is a trend toward entry of smaller companies which introduces a different energy mix and lower conservation potential. The main reasons usually offered for not participating in the surveys continue to be: extreme sensitivity to disclosure of operating information, difficulty in determining consistent units of production for meaningful comparison, and continued control over discretionary activities.

As well, some international companies control their performance monitoring functions from head office and choose not to respond to

CIPEC surveys.

A few multinational companies have ceased manufacturing in Canada and have since turned their sites into warehousing operations. Others have been affected by "product mandating" strategies where new products have been introduced and historical performance data is not yet available.

Some participants find the up-to-date information useful for competitive evaluations and for corporate incentive and bonus programs. In these cases, the participants eagerly respond to the surveys knowing they will receive timely consolidated data in return.

Weather

Changes in weather conditions also had a noticeable effect on energy utilization during 1987, particularly in smaller and less energy-intensive companies. Of the CIPEC sectors, the least energy-intensive Electrical and Electronic industry, with large HVAC loads, will notice changes in energy consumption more readily than big consumers such as Pulp and Paper companies.

As shown in Table VII, heating requirements were again lower in all areas of the country — particularly in the western provinces. Normal temperatures are determined by the mean temperatures recorded between 1951 to 1980. Figures for 1985 are shown to coincide with the new CIPEC performance reference year.

The usual number of severe winter storms and power outages were reported in the Atlantic provinces, causing considerable inconvenience to industry. Central Canada recorded the warmest winter since 1958. In Ontario alone, light fuel oil consumption was down 27%, pulling the total distillate product group demand down by nearly 10%. The western provinces also recorded warmer than normal winter temperatures. Hot summer temperatures also added to air conditioning loads of many localities and helped set record electrical peak demand loads.

It has been estimated that warmer temperatures have reduced CIPEC participants' heating requirements, accounting for 2.8% of the energy efficiency improvement since 1973.

Federal Government Activities

Although CIPEC is primarily a private sector initiative, government has an important role to play. The Business and Government Energy Management Division (BGEM) of the Department of Energy, Mines and Resources (EMR) is responsible for administering government's participation in the CIPEC program.

The focus of government support is on activities and programs designed to assist all industrial sectors in finding solutions to their energy-related problems and in achieving their conservation goals.

Depending on individual requirements, financial and technical assistance is made available to the CIPEC Council, sector task forces, individual companies and trade associations for administration, research and development, special economic and technical studies.

BGEM representatives assist with task force administration, attend council and task force meetings and help to develop practical "how-to" energy management conferences, workshops and seminars.

Close co-operation between government and the CIPEC network has brought significant benefit to both parties, and government has indicated that it wishes to build upon the success of the unique CIPEC partnership. As an example of this, EMR's proposed "Energy Efficiency and Diversity" initiative was outlined by their management to the CIPEC Council at its October meeting. The initiative proposes to place increased emphasis on support for the industrial and commercial sectors, particularly in the areas of research and development, information dissemination and technology transfer.

Table VII

Total Heating Degree-Days (°C below 18°C)

City	Prov.	1987	1985	Normal	87 vs 85 %
Vancouver	B.C.	1084	1487	1234	- 27
Calgary	Alta.	1840	2491	2181	- 26
Edmonton	Alta.	1849	2502	2288	- 26
Regina	Sask.	2021	2745	2325	- 26
Winnipeg	Man.	1986	2683	2247	- 26
London	Ont.	1426	1495	1499	- 5
Ottawa	Ont.	1718	1767	1746	- 3
Sudbury	Ont.	1945	2131	2057	- 9
Toronto	Ont.	1442	1506	1486	- 4
Montreal	Que.	1652	1695	1637	- 3
Quebec City	Que.	1961	1953	1910	0
Sherbrooke	Que.	1955	1969	2014	- 1
Fredericton	N.B.	1842	1915	1763	- 4
Halifax	N.S.	1508	1537	1407	- 2
Charlottetown	P.E.I.	1671	1743	1597	- 4
St. John's	Nfld.	1802	1943	1744	- 7

Source: Environment Canada



Chemical Industry

Energy Conservation Task Force

Dr. David Shearing
Chairman



General

The energy consumption and trends contained in this report are based on survey results of 46 member companies of The Canadian Chemical Producers' Association (CCPA). CCPA represents the chemical industry — located mainly in the provinces of Alberta, Ontario and Quebec — which produces a broad range of petrochemicals, inorganics and organic and specialty chemicals.

Although some chemical companies create products for sale at the consumer level, the vast majority make commodities and intermediates for other manufacturing industries. Thus, the productivity achieved in the chemical industry is a very significant determinant in the competitive strength of its downstream customers. Moreover, as a major upgrader of natural resources, a leader in the introduction and development of new technologies, and with an ever-increasing interna-

tional orientation, this industry is a vital contributor to the economic wealth of the nation.

Energy management and conservation normally receive intense scrutiny throughout the chemical industry because of the high costs of feedstocks, fuel and electricity. In many petrochemical companies, these costs can amount to as much as 70% of total manufacturing expenses. In 1987, it is estimated that approximately \$1,186 million was spent on fuel and electricity plus another \$3.9 billion on feedstocks.

On the basis of fuel and electrical consumption, this survey accounts for approximately 61% of the total chemical industry's energy usage. The Canadian chemical industry uses approximately 24% of the total fuel and electricity consumed in the manufacturing industry.

1987 Performance

The participating companies im-

proved their aggregated energy utilization by 5.2% during 1987. This result indicates that energy intensity has been lowered by 9.6% since the new 1985 base year level and 39.6% from the original 1973 reference year value. The industry has, therefore, achieved its 1990 goal of a 40% improvement three years ahead of schedule.

In the 1984 report, it was estimated that the weighted effects of new plant construction and general modernization accounted for 56% of the total improvement while implementation of major energy saving retrofits constituted 35%. House-keeping and maintenance provided the remaining 9%.

Responses to similar questions in 1987 indicated that construction of new plants and revised processes still contribute the largest magnitude of savings, but housekeeping and maintenance are providing a growing contribution to the total results.

The 1987 aggregated results show that about 27% of the total efficiency gain to date can be attributed to new plant construction, new processes, and associated productivity improvements. It is estimated that this source of energy cost savings amounts to \$883.8 million — after adjusting for annual price increases.

Benefits arising from upgraded process controls account for 25.9% of the total conservation achievement. This source of productivity improvement has generated accumulated savings of \$880.4 million since 1973. The impact of improving process controls is growing because of rapid advances in technology. For example, some of the larger companies are beginning to use a forerunner of Artificial Intelligence (AI) in their processes by adapting database programs which anticipate short and long-term operating performance. By anticipating the changing effects of catalyst activity, weather, etc., optimum process conditions can be maintained over longer periods of time.

In the third category (specific energy retrofits and equipment modifications), the 1984 aggregate contribution of 35% has dropped slightly to 31.9% in 1987. This trend is not unexpected in view of the reduced number of economically viable retrofit projects and slower energy price increases. Some typical examples of notable projects follow to illustrate the current focus of energy conservation attention. Since the beginning of the task force performance monitoring in 1973, the accumulated energy cost savings due to upgraded retrofits amount to some \$1,084.4 million.

The fourth category of housekeeping and maintenance improvements has increased from 9% in 1984 to 16% in 1987 giving rise to overall cost savings of \$544.6 million since 1973. Only one of the surveyed companies indicated this category to be their only source of improvement. This category, by definition, in-

cludes activities such as on-line adjustments to machinery and controls, increasing heat transfer rates by hull blasting or chemical treatment, minimizing plant downtime, etc. Housekeeping and maintenance are always a reliable source of savings when other improvements are not possible.

There was no common pattern to the source of efficiency gains in individual companies. No doubt each result is based on a unique blend of technological and business factors. It is interesting to note, however, that companies showing the highest productivity have the ability to identify their energy efficiency sources in considerable detail and usually include in their report several examples of completed projects.

Examples of Plant Improvements

Maintenance of steam distribution and insulation systems continue to be mentioned as the most common low-cost way to save energy. Frequent comments about installation of new low-excess oxygen burners with more reliable controls indicate that efforts are being made to raise combustion efficiencies. Other improvements in boilers and heaters involve techniques to maximize heat transfer in convection sections and recover blow-down waste heat. Tighter control of leakage from valves and machinery is another way to contain expensive process gases.

Analysis of processes and equipment, using "pinch technology" and other computerized modelling techniques, is resulting in installations of additional heat exchangers and heat pumps. These new sophisticated analytical techniques are also being used to debottleneck plant processes.

Examples of process changes include comments from a chlorine producing company which is continuing a multimillion dollar upgrading program on its mercury cells. By replacing the manually adjusted

graphite anodes with new stable metal anodes, cell resistance (K) factors are much lower and power requirements are greatly lessened. Another chemical firm reported large savings from the alteration of its filtration process, which results in less time for backwashing.

Companies also reported substantial efficiency gains from major alterations to machinery and equipment. For instance, one firm is now saving \$223,000 per year from a \$168,000 mechanical alteration to one of its older steam turbines. Another company reported that its 1986 investment of \$16 million for replacement of two large steam turbines with two 17-megawatt variable speed electric drives is expected to save up to \$11 million per year.

Energy Consumption Patterns

The industry's changes in energy consumption continue to display the effects of several short and long-term trends. Annual shifts are caused by fuel price competition, changes in processes and completion of retrofits, and start-up of new plants.

Long-term shifts, however, are influenced by fuel substitution incentive programs, energy conservation efforts, technological advances in processes and equipment, and compositional changes in the industry.

The most noticeable short-term change has been a 2% share increase in natural gas compared with 1986, at the expense of a 1.6% drop in heavy fuel oil, mainly as a result of deregulated natural gas prices. The gain of 1% in electricity's share reflects business growth in the electrochemical sector.

The chemical industry is continuing to recover by-products and wastes for use as secondary fuels. However, in 1987 the respondents reported that more of these wastes were being upgraded for sale which lowered its share from 14.7 to 13%.

Chemical Industry Energy Efficiency Improvement

Current year (1987) total energy inputs	317.133 petajoules
New base year (1985) equivalent energy inputs	350.309 petajoules
Gross Improvement = 9.5%	
Adjustments (environmental)	0.500 petajoules
Adjusted base year equivalent	350.809 petajoules
Net Improvement = 9.6%	
Efficiency gain 1973 - 1985	30.0
1986	4.4
1987	5.2
Total gain 1973 - 1987	39.6%

Chemical Industry Energy Use

<u>Type</u>	<u>Units</u>	<u>Petajoules</u>	<u>Percentage of Total Consumed</u>		
			<u>1987</u>	<u>1986</u>	<u>1985</u>
Natural Gas	4,185,953,000 m ³	155.717	49.1	47.1	53.0
Electricity	9,629,555 MWh	101.601	32.0	31.0	24.2
Liquid Petroleum Products					
Distillate Oil	92,916 m ³	3.796	1.2	0.5	2.9
Residual Oil	68,123 m ³	2.784	0.8	2.4	11.0
Diesel and Gasoline	4,272 m ³	0.170	0.1	0.1	0.2
Propane, LPG	113,990 m ³	3.092	1.0	1.5	1.4
Coal and Coke	56,210 tonnes	1.698	0.6	0.5	2.3
Other Fuels	n/a	41.285	13.0	14.7	4.0
Steam	n/a	6.990	2.2	2.2	1.0
Total		317.133			

Electricity is converted at 10,551 kJ/kWh

Other fuels include process by-products, vent gases, drips, slops, pitch, sulphur, hydrogen, waste oils, etc.

By-product hydrogen is now more valuable as a saleable commodity than as a fuel and is largely responsible for the reduced use of waste.

The industry's long-term (1980-1987) trends in energy consumption show a 10.2% drop in heavy fuel oil,

a 9% gain in use of wastes and a 7.8% gain in electricity. While these trends show the effects of the "off-oil" substitution program and energy conservation, the gain in electricity share reflects the changes in the reporting population where, in 1987, fewer of the petrochemical

companies participated in the survey.

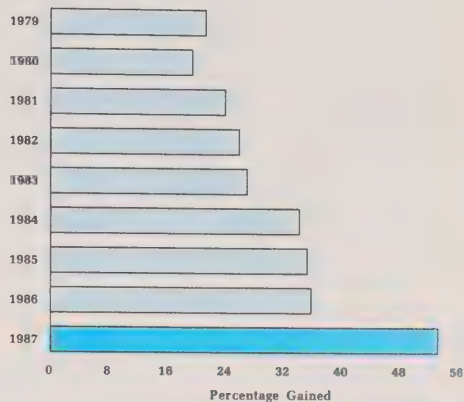
The possibility of further fuel switching is remote as companies have taken full advantage of substitution programs and price incentives.



Electrical and Electronic Industry

Energy Conservation Task Force

Seth Duffus
Chairman



A Banner Year

Significant productivity improvements, new manufacturing techniques and improved survey reporting are among the many factors that helped the electrical and electronic industry post a record 16.2% improvement in energy efficiency in 1987.

This represents the greatest one year energy improvement in the sector since the base year 1975, and brings total efficiency improvements since that base year to 54%. A measure of the Electrical and Electronic Industry Task Force's success is the fact that it has exceeded its 1990 target of a 45% improvement in energy efficiency over the base year a full three years early.

The significant improvements in energy efficiency reflect that 1987 was a banner year for the electrical and electronic industry. Manufacturing activity grew between 7% and

8%. Capacity utilization, which recently hovered in the 60 to 70% range, topped 80% in 1987. The result for many companies was a substantial increase in productivity — and energy productivity improvements that in some cases were as high as 30 and 40% for 1987 alone.

The Sector

The more than 150 companies represented by this task force manufacture a diverse range of products used in the generation, transmission and distribution of electricity. These include generators, transformers, switchgear, lighting equipment, wire and cable and electrical appliances, as well as a host of electronic products and systems and related high technology components. Most of the companies are members of the Electrical and Electronic Manufacturers Association of Canada (EEMAC) which acts as a secretariat for the task force.

Productivity Gains and Energy Use

As indicated earlier, a major factor in the 16.2% increase in energy efficiency in 1987 was an improved productivity picture. Better use of installed capacity combined with a continued commitment to a "lean and mean" business philosophy paid off on the energy front: output/overhead ratios improved, resulting in significant increases in energy efficiency. Specifically, the following factors contributed to the sector's energy results.

- Automation, computerization and robotics: The introduction of new technologies such as CAD/CAM and programmable controllers continued to affect the energy picture. On the one hand, they helped reduce labour costs and improve output, thus contributing to improved energy efficiency. As well, increased automation and computerization

prompted a noticeable shift in consumption to electricity; of all the energy sources, electricity alone has posted a steady increase in consumption since 1979, while oil and gas use has declined. (In 1979, electricity accounted for 30% of energy used by the sector, compared with 41% in 1987.)

- **Product rationalization:** To be competitive globally, more and more companies in the sector are rationalizing and upgrading processes to produce a limited number of specific products (in some cases, only one product) for world markets, where once they might have manufactured a diverse product line for much smaller markets. Resulting productivity gains are reflected in improved energy efficiency.
- **New process design:** As energy costs become a concern at all levels of plant engineering, energy conservation has become part of process design. Products are made with newer, lighter materials, require less manufacturing time to produce and often are more energy efficient operationally. Thus there are energy payoffs on several fronts.

Task Force Activities

In addition to offering two more of the successful technology transfer workshops on "Heating, Ventilating

and Air Conditioning," the task force last year organized a series of plant tours designed to give sector members first hand insights into innovative and successful energy management practices used by its members.

More importantly, the task force began the process of reassessing its role and future in an era when energy conservation is seemingly low on many companies' priority lists. To this end, a questionnaire was sent to all members and a followup brainstorming session held to discuss members' views. Mr. Bev Markle, a former task force chairman, was retained as a consultant to simplify the energy management survey form and examine ways of increasing participation in task force activities. The increase in the number of companies participating in the survey to 45 in 1987 from 34 the previous year is testimony to his success.

The Year Ahead

Although gratifying, the sector's 1987 energy efficiency improvements are unlikely to be repeated in 1988: even if manufacturing activity continues at its present pace, most companies will be able to squeeze only marginal productivity improvements out of their operations.

The challenge for the task force is to help industries discover new op-

portunities to conserve energy — a task it is well positioned to undertake as the electrical and electronic sector is both a producer and user of equipment designed to help companies conserve energy.

A major opportunity, for example, lies in the area of environmental control: heating and air conditioning systems consume 48% of energy used by industry, yet are among the most poorly maintained systems in many operations. The technology exists — in the form of microprocessors, programmable controllers and similar equipment manufactured by companies in the electrical and electronic sector — to not only substantially reduce energy costs, but also make energy management easier.

The task force's job, in 1988 and beyond, will be to encourage plant engineering staff in all industries to use the state-of-the-art equipment available to them to better manage their energy resources, and to help them with the data reporting so as to accurately present the sector's performance.

Electrical and Electronic Industry Energy Efficiency Improvement

Current year (1987) total energy inputs	6,689,830 gigajoules
New base year (1986) equivalent energy inputs	7,981,429 gigajoules

Net Improvement = 16.2%

Adjustments — None

Efficiency gain 1975 - 1985	36.1
1986	1.9
1987	16.2
Total gain 1975 - 1987	54.2%

Electrical and Electronic Industry Energy Use

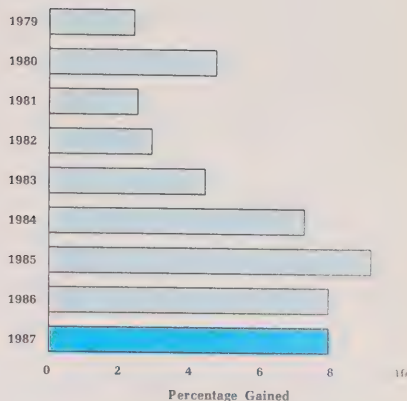
<u>Type</u>	<u>Units</u>	<u>Gigajoules</u>	<u>Percentage of Total Consumed</u>		
			<u>1987</u>	<u>1986</u>	<u>1985</u>
Natural Gas	98,477,397 m ³	3,663,362	54.8	57.3	59.6
Electricity	763,441 MWh	2,748,388	41.1	37.5	33.5
Liquid Petroleum Products					
Distillate Oil	1,566 kilolitres	61,064	0.9	1.4	0.6
Residual Oil	2,058 kilolitres	83,353	1.2	1.8	0.7
Diesel and Gasoline	249 kilolitres	9,570	0.1	0.4	0.1
Other Fuels					
Propane	3,006 kilolitres	80,126	1.2	0.3	4.0
Steam	24,836,431 kilograms	43,967	0.7	1.3	1.5
Totals	1987	6,689,830			
	1986	5,806,412			
	1985	5,841,065			
	1984	8,778,400			
	1983	8,886,142			
	1982	8,718,000			



Ferrous Metals Industry

Energy Conservation Task Force

Don W.R. George
Chairman



Task Force Description

The Ferrous Metals Industry Energy Conservation Task Force is represented by the steelmakers who comprise the Ferrous Industry Energy Research Association (FERA). The companies which provided data for the 1987 energy efficiency assessment include:

- Algoma Steel Corporation
- Dofasco Inc.
- Sidbec-Dosco Inc.
- Stelco Inc.
- Sydney Steel Corporation (Sysco)

Together, these companies represent about 85% of the total Canadian raw steel production and produce steel by the following techniques:

- blast furnace, basic oxygen and/or open hearth process
- direct reduction/electric furnace
- electric steelmaking furnace

A partial listing of steel products would include:

- structural shapes
- rails
- flat rolled products
- forgings
- fasteners
- coated steel
- castings
- tubular products
- bar products
- wire and wire products

Steel is produced and/or processed at 33 plants among the member companies.

1987 Composite Energy Performance

Steel production increased in 1987 to 11,856,731 tonnes from 11,594,290 tonnes in 1986 — an increase of 2.3%.

The amount of energy consumed per tonne of raw steel was marginally lower in 1987 at 22.87×10^9 Joules, compared with 1986 at 22.90×10^9 Joules (a decrease of 0.1%).

All participating companies achieved success in their plant energy conservation programs, with a number of these achievements listed at the end of this report. However, certain factors overshadowed the conservation achievements in 1987 and resulted in little change in the composite energy rate. Some of these negative factors include:

- Reduced scrap proportions in the steelmaking process.
- Interruptions to the normal operating pace due to major construction projects and breakdowns.
- A shift towards more energy intensive products.

Progress Towards the 1990 Energy Rate Goal

In 1987, the energy rate at 22.87×10^9 Joules/tonne was 1.1% higher than the new base year of 1985, and is 9.4% higher than the energy goal in 1990 of 20.91×10^9 Joules/tonne.

Task Force Technical Activities

The FERA Technical Committee continued to foster activities geared to assisting member companies improve their energy performance.

In the main committee:

- A new format was developed for documenting and exchanging case studies on member company energy conservation achievements, and 11 were exchanged.
- Technical discussions were held on flue gas oxygen measurement, and by-product fuel dispatching.
- A list of potential joint projects was reviewed and two (electric speed control, and industrial heat pumps) were selected for further expansion.

A Steam Conservation Workshop was held in September 1987 in Burlington, Ontario. This was co-sponsored with Energy, Mines and Resources (EMR) and attracted 39 participants and speakers from the four member companies with major steam systems.

At FERA's request, EMR also hosted a tour of the Combustion and Carbonization Research Laboratory (CCRL), followed by presentations on coal-water fuels, plasma technology applications, and industrial flue gas condensing boilers.

FERA continued to monitor developments of the International Flame Research Foundation (IFRF) through a designated representative who, in 1987, attended two meetings of the American Flame Research Committee (AFRC). FERA is making plans to host the Spring meeting of

this committee in Toronto in May 1988.

Conservation Projects for 1988

All participating companies expect to implement energy saving measures in 1988. A sampling of the more significant items include:

- Extension of preheat tunnels on galvanizing lines to reduce the fuel rate.
- Redesign of slab reheat furnace to increase capacity and fuel efficiency.
- Addition of automated hinged lids on steelmaking vessels.
- Modification of plant equipment and practices to better utilize internally generated fuels.

1987 Energy Conservation Achievements

The following is a partial listing of energy conservation achievements by task force members in 1987.

New Energy Efficient Installations

- Two new slab reheat furnaces with unfired preheat zone, 1200°F combustion air preheat, computer

control, upgraded insulation and steam recovery from evaporative skid cooling.

- Start-up of two new slab casters which eliminate the energy use in heating and rolling ingots into slabs.
- Start-up of new seamless tube mill, complete with full computer control and efficient reheat furnaces.

Modifications to Existing Equipment

- Modifications to rail mill and slab furnaces to improve insulation and reduce air filtration.
- Replacement of conventional burners on rail mill furnaces with 100% oxygen enriched burners.
- Rebuild of boiler feedwater system to improve the boiler house steam balance and eliminate exhaust steam venting.
- Refurbished coke oven battery to burn surplus blast furnace gas.

Operating Changes

- Better scheduling of by-product fuel users to reduce flaring.
- Increased steam production on boilers with the highest efficiency rating.



- Modified the fuel firing on blast furnace stoves to ensure a steady fuel flow.
- Modified the steam production and by-product fuel use in the boiler house to reduce variation in by-product fuel demand.

Housekeeping and Repetitive Maintenance

- Programs to assess and improve building heating.
- Steam system conservation programs (traps, leaks, insulation).

- Increased involvement of the operating people in the energy management of their processes.
- Maintenance of gas distribution systems to increase utilization of by-product fuels.

Ferrous Metals Industry Energy Efficiency Improvement

Current year (1987) total energy inputs	271,138 terajoules
New base year (1985) equivalent energy inputs	268,297 terajoules

Net Improvement = -1.1%

Adjustments — None

Efficiency gain 1974 - 1985	9.1
1986	-1.2
1987	0.1
Total gain 1974 - 1987	8.0%

Ferrous Metals Industry Energy Use

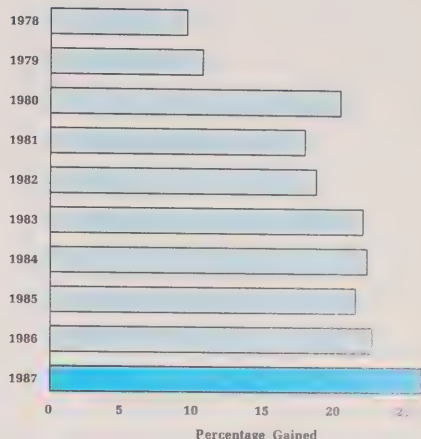
Type	Units	Terajoules	Percentage of Total Consumed	
			1987	1986
Natural Gas	1,427,500,000 m ³	53,103	19.6	19.7
Electricity	5,709,444 MWh	20,554	7.6	7.6
Liquid Petroleum Products				
Residual Oil	343,209,880 litres	13,900	5.1	4.6
Coal	6,330,380 tonnes	183,581	67.7	68.1
Total		271,138		



Food and Beverage Industry

Energy Conservation Task Force

Alexis L.W. Hyland
Chairman



This report covers an estimated 34% of the total food and beverage industry energy consumption. There is almost complete coverage of energy-intensive brewing, distilling, starch manufacturing, and sugar refining industries. The remaining sectors are composed of hundreds of small firms scattered throughout the country.

1987 Performance

The participating companies in this year's survey achieved an impressive gain of 3.15%, raising total efficiency to 25.92% relative to the 1977 base year. As a result, estimated pre-tax savings of \$6.5 million were made available for other productive purposes.

Factors which affect energy performance in the food and beverage industry are shown in a table. In spite of very little growth in Gross Domestic Product (GDP), the amount of spending on new machin-

ery and equipment has doubled since 1978. However, capacity utilization continues to fall — particularly in the beverage industry which has already seen extensive rationalization of older plants. These trends clearly reflect an awareness of the need for productivity improvements.

With little hope of expanding in the domestic market, which would increase profits and general productivity, the proposed Free Trade Agreement (FTA) is being viewed with mixed feelings. In a recent industry survey, when asked what impact the FTA might have on their company, 10.7% of management thought it would provide "strong growth", 32% said it would result in "moderate growth", but 35% felt there would be "little change", and 10% foresee a moderate decline in business. Regardless of the final outcome, companies in this industry will continue to experience very strong domestic and international

competition and will have to modernize at a faster pace.

Task Force Activities

Task force activities featured development of a special computer software program that analyzes daily energy use patterns. The program was designed to reveal off-peak (base load) consumption and pinpoint locations for energy conservation. Input data is taken from meters and production records. It will be made available to interested companies in the industry.

Other activities involved presentation of an energy management seminar in Montreal and distribution of quarterly newsletters.

Group Performance

Bakeries

Energy utilization in this sector comprising Canada's largest inte-

grated bakeries, improved 5.3% in 1987 boosting the total gain since 1979 to 17.9%. The average energy intensity of the participating companies is now 2691 kJ/kg. This intensity is about 16% higher than U.S. bakeries where economies of scale provide distinct advantages. One Canadian company is now planning a state-of-the-art "super" bakery in the Toronto region, which will introduce new efficiencies by concentrating bread production in the new plant while retaining specialty products in its smaller plants.

Baking technology has slowly improved in recent years which has allowed faster baking times and less energy use in the preparation and finishing stages. For example, residence time in ovens is down to about 18 minutes. Electricity use has slowly grown to the current level of 22%, while the natural gas and fuel oil shares have dropped to 72.2%. Recorded production quantities have remained virtually the same over the past five years.

Biscuit Manufacturers

Performance varies considerably throughout this sector because of a wide mix of products and company size. Energy intensity varies between 5000 to 7000 kilojoules per kilogram of product and accounts for 5 to 15% of total manufacturing expenses. Through continued careful monitoring of processes, milder weather, and operation at top capacities, energy utilization was improved 3.8% during 1987. This raises the total improvement since 1979 to 15.4%.

The proportions of total energy consumption (electricity 22.5%, natural gas 68.3%), have not changed significantly in the past five years in this mature industry.

Breweries

This sector consists of three large multiplant companies and five

intermediate-sized breweries. There is a growing number of micro-breweries in Canada but these are not yet included in the survey.

Energy efficiency improved 1.4% in 1987, raising the total gain to 7.5% since 1975. The industry uses an average 299 megajoules per hectolitre of production, down from 306 MJ/HL in 1986. The improvement is partly due to a 3% increase in production, but more importantly from constant attention to housekeeping activities. Energy efficiency is highly sensitive to capacity utilization levels, which were uneven across the industry because of the shifting popularity of different brands.

Brewers are very energy conscious even though energy costs represent only 3% of their total manufacturing expenses. The three largest companies use sophisticated computer accounting systems to monitor monthly performance. The smaller companies tend to rely on traditional cost accounting methods.

In addition to housekeeping and minor retrofit projects, one of the major companies is now installing a submetering demonstration project in co-operation with the Ontario Ministry of Energy and Ontario Hydro. Other companies are updating their technical audits to identify possible savings. One of the smaller companies reported setting up an energy management committee. One quarter of the companies reported installing energy conservation retrofits in 1987, and the same number plan to do so in 1988.

Distilleries

The distilling industry is going through a major down-sizing as a result of a 25% reduction in sales in the past five years.

This rationalization and concentrated efforts to improve energy utilization in the existing plants has resulted in a respectable efficiency

gain of 2.5% in 1987. Overall, efficiency has been improved 26% since 1976. Average energy intensity has thus been lowered to 40,594 kilojoules per (absolute) litre.

Three-quarters of the companies reported completion of energy conservation projects during 1987 and report plans for additional projects in 1988. Many of these projects are the outcome of recent plant audits. For instance, retrofits to distillation columns and reboilers, installation of vapour recompression machinery, recovery of boiler blow-down energy, new burner controls, and better plant heating systems, were the means for improving intensities.

The proportion of natural gas consumption is now down to 80.4% compared with 90% in 1984. Meanwhile, the electricity share has grown to 18% from 8%. Token quantities of fuel oil are used only for backup purposes. Because purchased natural gas quantities are very large throughout this industry, the largest companies are able to use "buy/sell" contract arrangements with Western producers, while the smaller companies receive sizeable discounts from their local utility.

Confectionery Manufacturers

After making some very impressive efficiency improvements between 1980 and 1985, energy utilization increased only 0.9% in 1987. This sector is also experiencing major rationalizations with some plant closings and consolidation of product lines in expanded facilities. The results of these changes have not yet been realized.

Companies are continuing their energy conservation activities, however, and cite waste heat recovery, equipment and piping system insulation projects, and replacement of steam vacuum jets with mechanical pumps as sources of cost savings.

The participants spent approximately \$9.3 million on electricity

and fuel, which was 10 to 15% of their total manufacturing expenses. Electricity supplied 31.6% of total consumption and natural gas virtually all of the remainder.

The energy intensity of products varies considerably throughout the reporting companies. Manufacturers of ice cream require approximately 15 MJ/kg, chocolate producers use about 13 MJ/kg, and other confectioneries demand about half of the latter amount because of less processing and refrigeration.

Food Processors

Energy management in this group of companies is especially difficult because of the seasonal swings in production and large turnover of product lines which require very flexible processing equipment. Food processing requires heating and cooling large quantities of water for pre-cooking, sterilization, and handling of the various raw materials. Thus, energy conservation focuses on these operations.

The participants in the survey improved their energy utilization by 4.9% in 1987. The total gain is 23.1% since 1976. Much of this improvement has been achieved from changes to the steam plants, i.e., automation of boiler operation, maintenance of steam traps, installation of economizers, pre-heating boiler feed-water with solar energy, increased recovery of condensate, etc. One company is now installing cogeneration equipment to take advantage of the balanced steam and electrical load situation to lower its purchased costs of energy.

All of the participants reported that energy costs and performance are monitored on a monthly basis, and nearly one-quarter of the larger companies are able to track efficiency of submetered processes on a daily schedule.

Fisheries

Efficiencies in the greatly rationalized fisheries industry improved 2.6% during 1987, which raises the total gain to 26.5% since 1977.

It is estimated that the participants spent \$5.9 million on electricity, and another \$6.3 million on fuel for factory use. Energy costs usually amount to about 10% of total processing costs. Heavy fuel oil is the predominant source of fuel because of the size and location of the plants. In previous years, sizeable quantities of waste fish oil were used for energy, but companies are now re-processing it for industrial use as fish meal and oil.

The improvements in the fish industry have been helped by increased production of high value-added products, which has increased profit margins and investment in new equipment. For example, innovative computer monitoring of fillet cutting has vastly reduced waste and increased output. New fish freezing methods, such as the "blast" technique of circulating chilled and properly humidified air around large batches in controlled room environments, or in continuously fed tunnel arrangements, are replacing the older "slow" brine immersion systems.

Grocery Products

The diversity of products made by the companies in this sector make it difficult to generalize on the aggregated results. What is common, however, is the strong efforts being given to energy conservation. Energy efficiency in this group improved 6% during 1987 to raise the total amount of energy conserved since 1977 to 32%.

Typical energy conservation activities cited in the 1987 survey were: boiler flue gas heat recovery projects, boiler automation, lighting improvements, and installation of

unit heaters to allow shutdown of large boilers in the off-season. Some changes in processes, and on-site generation of nitrogen, were also actions which helped performance during 1987.

Three-quarters of the total energy used is supplied by natural gas, with electricity supplying 20%, and fuel oil and propane the remainder. All of the participating companies in this sector are large enough to benefit handsomely from discounted natural gas prices and/or "buy/sell" direct purchase arrangements.

The annualized rate of improvement of 3.2% means the participating companies saved about \$644,000 in energy costs in 1987 alone.

Meat Packers

After experiencing a decrease in energy performance in 1986 the participants reported a gain of 5.3% in 1987. This raises the total performance to 41.9% since 1977. The actions cited for these accomplishments were additional waste heat recovery in the powerhouses and singeing operations, attention to combustion efficiencies, weekend shutdown of unused equipment and upgrading plant lighting systems. Tighter control of production scheduling and operating procedures, plus higher maintenance standards were also mentioned as major reasons for productivity gains.

Extensive modernization of plants is now underway in the larger companies. These changes are being made primarily to increase product variety and quality, with positive impact on energy utilization.

Thirty-one percent of the total energy is supplied by electricity, while 67% comes from natural gas.

Poultry and Egg Processors

This sector includes a mix of poultry and egg processors with slightly dif-

ferent energy requirements. For example, energy intensity for the egg and egg-product processors averages about 4500 kJ/kg while the poultry processors' average is 2540 kJ/kg of product.

Energy utilization improved 3.1% in 1987, raising the total to 11.8% over 1982 operating conditions. These gains have been achieved mainly by improved plant HVAC systems and by recovery of waste heat from the scalding water.

The companies in this sector get about 48% of their energy from electricity. Propane usually supplies 1.7%, and diesel and gasoline contribute 7.5% of the total consumption. Heating requirements are supplied by the locally available fossil fuels, i.e., natural gas in urban centres, distillate fuel oil in rural areas. The unit costs for heating appear to be about \$6.24/tonne for those using natural gas, and \$5.12/tonne for the fuel oil users. The difference may stem from the fact that plants reporting fuel oil consumption tended to be larger and located in Quebec where oil is more economical.

Companies in this sector have not benefited from natural gas deregulation because of low annual consumption, but the potential for grouping together in a purchasing co-op may bring cost savings in the near future.

Soft Drink Producers

The carbonated beverage industry consists of many independent companies that make a number of popular brands under licence. Energy is mainly used for HVAC, sterilization, bottling operations, and raw material refrigeration. Bottlers require about 3500 to 4000 kilojoules per litre, while canners use 1000 to 1500 kJ per litre.

This sector experienced a 0.06% increase in energy intensity in 1987, probably due to the number of com-

panies reporting for the first time. The total efficiency gain is 28.1% over aggregate 1980 operating conditions. Several companies which reported performance increases cited the milder weather in the past two years as a contributing factor, as well as tighter production schedules and minor building heating improvements.

Typical energy costs are \$50,000 for the smaller plants and \$400,000 for larger urban plants. This sector is also experiencing some concentration where fewer, but larger, more efficient plants are emerging.

Starch Manufacturers

The companies in this sector manufacture a mix of products, including wheat and corn starches, glucose, alcohol, gluten feeds, adhesives and resins. Efficiency gained 0.4% in 1987 to raise the total improvement to 32.4% over 1976 operating conditions.

Productivity gains were low in 1987 because most of the plants were running at top capacity and the improvements from previous energy conservation efforts have already been seen in the results. However, future gains should be forthcoming from biogas recovery projects and upgrading of instrumentation systems with computerized controls. This sector is already an advanced technology user, with one company

cogenerating most of its own electricity.

Approximately \$31.7 million was spent on fuel and electricity. Natural gas supplied 80.7% of the total energy, while purchased electricity accounted for nearly 17%. The companies have all taken advantage of the deregulated natural gas market situation, most favouring the "buy/sell" direct purchase option. Only one company opted for the "competitive market program" (CMP) discounts.

Proportions of energy shares have not changed since the beginning of performance monitoring and there appears to be little possibility of fuel substitution.

Sugar Manufacturers

Performance gained 0.7% over 1986, raising the total gain since 1975 to 31.5%, in spite of a 7.5% drop in production.

The energy intensity of American sugar plants average 3541 MJ/tonne. Canadian sugar refining industry's energy intensity is 3686 MJ/tonne.

Canadian plants, however, appear to use twice the amount of electricity in their operations (4.0%) compared with the American average of 2.3% because lower electrical prices favour purchase from the local utilities rather than in-house generation.

Food and Beverage Industry Energy Efficiency Improvement

Current year (1987) total energy inputs	37,615,448 gigajoules
New base year (1985) equivalent energy inputs	39,342,000 gigajoules
Net Improvement	= 4.4%
Adjustments — None	
Efficiency gain 1977 - 1985	21.5
1986	1.2
1987	3.2
Total gain 1977 - 1987	25.9%

Energy conservation is a major concern in this industry as indicated by the number of companies planning new audits of their facilities. Some companies have already taken advantage of the provincially sponsored programs and are reviewing the results for further improvements.

Energy Use Patterns

The relative shares of energy have not changed more than 2% in the last seven years, with a slow trend toward greater use of electricity and less heavy fuel oil. These shifts re-

flect conservation of combustion fuel and greater use of automated equipment. Electricity now supplies 20.8% of the total, while the natural gas share is 68.3%, fuel oil 9.1%, and miscellaneous fuels the remaining 1.8%.

Future Outlook

Faced with mature processes and slow to moderate volume growth, future efficiency gains will depend primarily on close attention to the fundamentals of energy management. This involves frequent monitoring and analysis, adherence

to good operating and maintenance standards, and replacement of inefficient equipment. Continued rationalization of obsolete plants will help, but this will be slow given the need to amortize existing plants and equipment.

It is now expected that accelerating energy prices will raise the importance of energy conservation and direct more investment into improvement projects. Waste heat recovery will probably continue to be the most important source of engineered savings.

Food and Beverage Industry			Percentage of	
Energy Use			Total Consumed	
Type	Units	Gigajoules	1987	1981
Natural Gas	690,997,810 m ³	25,705,118	68.3	64.8
Electricity	2,168,663 MWh	7,807,187	20.8	14.6
Liquid Petroleum Products				
Distillate Oil	85,390,541 litres	3,441,599	9.1	19.6
Residual Oil				
Diesel and Gasoline	8,577,062 litres	328,812	0.8	0.6
Other Fuels				
Propane	7,976,583 litres	212,177	0.6	0.4
Steam	n/a	109,900	0.3	—
Others	n/a	10,655	0.1	—
Total		37,615,448		

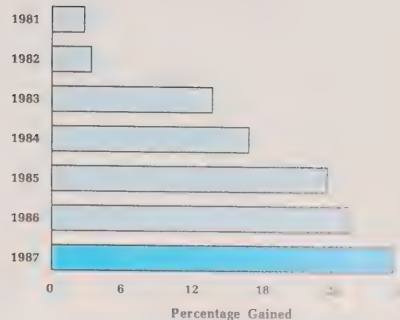
Energy Performance						
Industry	Original Base Year	Number in Survey	Improvement		Energy Costs \$'000	Annualized Savings \$'000
			1987 %	Total %		
Bakeries	1979	6	5.33	17.93	7,616	175
Biscuit Manufacturers	1979	6	3.82	15.44	6,562	129
Breweries	1975	8	1.41	7.53	43,926	292
Confectionery Manufacturers	1978	9	0.93	25.16	9,344	363
Distilleries	1976	12	2.51	26.01	25,099	765
Fisheries	1977	4	2.61	26.51	12,195	362
Food Processors	1976	14	4.87	23.06	35,619	763
Grocery Products	1977	12	6.04	32.03	18,242	644
Meat Packers	1977	10	5.27	41.94	24,571	1,135
Poultry and Egg Processors	1982	13	3.09	11.79	7,141	172
Soft Drink Producers	1980	29	-0.06	28.14	6,360	266
Starch Manufacturers	1976	4	0.39	32.40	31,742	963
Sugar Refineries	1975	5	0.75	31.46	20,705	543
	1977	132	3.15	25.92	\$249,122	\$6,572



General Manufacturing

Energy Conservation Task Force

Bent K. Larsen
Chairman



The following report is based on a survey of the energy management activities of a group of member companies of The Canadian Manufacturers' Association (CMA). These companies are not part of any of the other sector conservation task forces. The mix of manufacturing and processing operations among the general manufacturing participants is quite diverse.

However, the respondents (in 1987, 57 companies representing 190 manufacturing plants) generally provide a good indication of energy productivity changes and conditions found throughout the whole manufacturing industry in Canada.

General Performance and Business Conditions

Energy utilization in the participating firms improved 3.8% during 1987. Thus, the general manufacturing task force total efficiency improvement is now 29.1% since the

1981 base year.

It is estimated that participants spent \$60.5 million on electricity this year, \$28.1 million on natural gas, and \$4.6 million on petroleum products. However, cost savings of \$3.7 million have been realized, based on the annualized rate of performance improvement of 3.8%. Furthermore, the accumulated savings for all participants (at current energy prices) now amount to about \$41 million.

In 1987, participating companies focused most of their attention on improving profit margins and meeting production commitments, rather than on productivity improvement. Therefore, gains that were realized could have arisen primarily from good business conditions as shown in the graph. According to Statistics Canada figures, the Gross Domestic Product (GDP) index rose 4.7%, capacity utilization was stable at 80%, and the capital investment index

increased by 8.7%. All these factors are generally very favourable to energy utilization improvement.

In spite of these satisfactory gains more will have to be done in the near future to meet the growing pressure to be competitive and technologically current.

In a recent CMA "Issues" survey there was widespread agreement that the rate of future capital investment and R&D must rise. Of managers surveyed, 5.7% felt they had "leading-edge technologies and facilities", 22% thought they were "all up-to-date", 60.8% were "somewhat up-to-date", and only 8.3% were operating with "generally obsolete systems". According to these executives, free trade competition will result in even greater domestic investment (33.4%), as opposed to no change in current intentions (29.7%).

What's more, companies indicate that investment in new manufacturing

ing technology over the next three years will be "very significant" (30.6%) and "moderate" (45.5%), compared with only 19% of executives who saw "very little" need for improvement. All this suggests that more effort is going towards modernization which should bring with it the increased energy savings which are so much a part of most new manufacturing technologies.

Long-term analyses of the effect of escalating energy prices on end-use energy demand have found that a 10% increase in energy prices brings about a 3.4% reduction in energy demand. That was the finding of an International Energy Agency study which included North American industry. The analysis attempted to exclude the side effects of income growth and major structural changes that were not primarily or directly dependent on end-use energy prices.

The analysis also discovered that in periods of falling energy prices, demand generally increased less than 3.4% for a 10% decrease in energy price.

Supporting evidence for this study is found in the general manufacturing industry, where average energy prices have increased by 89% since 1981, and which has posted a 29.1% improvement in energy utilization. Thus, for each 10% increase in energy price, the energy utilization (demand) has been reduced virtually the same, 3.3%.

Group Trends

Rubber Products

The five reporting companies in this group showed an aggregate 3.2% saving for 1987. Their energy costs usually vary between \$1.2 and \$5 million per year.

The large amount of electricity used in this sector — 31% of their total consumption — has prompted many of the participants to focus more attention on demand management control.

Electricity consumption is becoming a very important issue, especially in Ontario where "time-of-use" (TOU) rates will be introduced in the near future. In other provinces demand charges are rising and penalties are high because there are no ratchet clauses, that is, the peak demand reached during any one month sets the demand charge for the full year.

Fossil fuels accounted for 67% of the participating companies' total energy consumption. Those companies with access to natural gas have taken full advantage of the various discount programs offered by local gas utilities, with cost savings in the order of 5 to 10%.

However, because of low profit margins and small capital improvement budgets, plus the general uncertainty surrounding this sector, energy conservation improvements are kept at the low-cost level throughout most of the sector.

Chemical, Pharmaceutical and Medical Products

The seven companies in this group report a weighted average improvement of 2%. Energy costs for the 28 different plants vary widely from \$35,000 to \$2.5 million. Productivity has improved 20% since its aggregated 1981 base year.

Companies report facility-related energy conservation projects, including recovery of waste heat and electrical demand control. In spite of the low potential for process improvements, all reports were submitted by staff with titles such as: energy co-ordinator, plant services engineer, utilities engineer, energy program co-ordinator, etc., which suggests that energy management is a very worthwhile activity in these firms.

While there appeared to be high energy monitoring standards throughout this group, demonstrated by the use of specialized

performance monitoring programs, there was a wide divergence in the application of some common energy conservation equipment, such as electrical demand controls and stack gas recuperators. Reports also indicate that Quebec operations are progressing towards more electrification of plants and heating systems, while Ontario companies are benefiting more from deregulated natural gas contracts.

Foundries, Forging, and Heavy Metal Operations

Sixteen companies in this high energy-intensity category had efficiency gains that averaged 5.2% for the year. This group has improved energy utilization 12.6% over 1981 consumption rates, despite assorted setbacks experienced during the recession.

The energy conservation actions in this group are quite progressive because of high-energy to manufacturing-cost ratios of 10 to 15%, and because of competitive pressures brought on by new foreign entrants into the industry. Notable energy savings have been realized through unusual projects such as oxygen enrichment combustion systems, conversion of pneumatic power systems from steam to compressed air, and changeover to continuous rather than batch operation. More conventional projects include conversion to induction heating on furnaces — especially in Quebec where very attractive off-peak power rates exist for high-load factor customers. Heat recovery and housekeeping actions continue to be the mainstay of energy conservation in this sector.

Energy intensities in ferrous casting operations range between 4600 to 5700 megajoules/tonne depending on the size and finishing requirements of the products. Non-ferrous castings require about 3300 to 3500 megajoules/tonne due to lower melting temperatures and simpler casting methods. Forging operations often require 25,000 to 30,000

megajoules/tonne when several billet reheating steps are required and product heat treatment is involved.

The major gas consumers in this group are also enjoying large savings from deregulated natural gas contracts. Opportunities still exist for substitution of fossil fuels with electricity.

According to the survey, additional process heat recovery is possible, but the capital outlay would be high because of clean-up requirements.

Light Manufacturing

Twenty-nine companies reported an aggregate productivity improvement of 3.3% on their total energy consumption, estimated to cost \$27.2 million.

The companies in this group make a huge variety of items primarily for the consumer and construction markets. They are as much alike as alfalfa processing is to the manufacture of snowmobiles. Energy use therefore varies considerably in each operation but generally shows a pattern of about 25% electricity, 70% natural gas for buildings and miscellaneous heating and drying, and around 5% for plant vehicles. Energy costs fall between 5 and 10% of total production expenses. Because of the large amount of energy used for heating, several companies mentioned lower consumption because of the warmer weather during 1987.

Manufacturers in this sector are generally concerned about the energy losses from the building envelopes and recovery of waste heat from exhaust systems and equipment such as air compressors. Re-

sults of recent energy audits done in this sector show that added building and equipment insulation is still justified in two-thirds of the instances. The frequency of economically viable heat recovery projects applies to about one-third of the sites, and it has been found that about one-quarter of plants should still make power factor and load control improvements.

Typical plant energy-intensities in this group are: metal stamping operations, 640 kW/m² of floor space; office equipment and furniture manufacturing, 795 kW/m²; scientific and photographic equipment plants, 830 kW/m²; aluminum extruders, 1080 kW/m²; and machine shop type operations, 1150 kW/m².



General Manufacturing Industry Energy Use

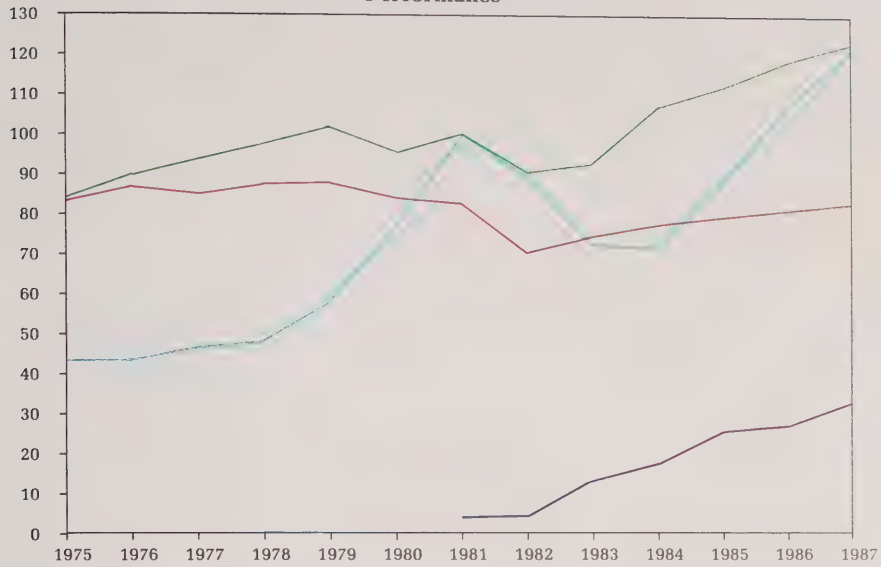
<u>Type</u>	<u>Units</u>	<u>Gigajoules</u>	<u>Percentage of Total Consumed</u>		
			<u>1987</u>	<u>1986</u>	<u>1985</u>
Natural Gas	234,822,181 m ³	8,735,851	51.7	53.6	60.2
Electricity	1,765,668 MWh	6,356,405	37.6	35.3	28.1
Liquid Petroleum Products					
Distillate Oil	921,065 litres	35,921	0.2	0.7	1.2
Residual Oil	36,516,788 litres	1,478,930	8.8	8.5	9.6
Diesel	2,637,276 litres	105,227	0.6	0.7	0.4
Gasoline	2,444,076 litres	88,475	0.5	0.5	0.1
Other Fuels					
Propane	1,979,660 litres	52,659	0.3	0.3	0.3
Steam	n/a	36,447	0.2	0.2	—
Others	n/a	22,471	0.1	0.2	0.1
Total		16,912,386			

General Manufacturing Industry Energy Efficiency Improvement

Current year (1987) total energy inputs	16,912,386 gigajoules
New base year (1985) equivalent energy inputs	17,943,940 gigajoules
Net Improvement	= 5.7%
Adjustments — None	
Efficiency gain 1981 - 1985	23.4
1986	1.9
1987	3.8
Total gain 1981 - 1987	29.1%

General Manufacturing

Performance



Legend: ■ GDP Index ('81 = 100)
■ Capital Investment Index ('81 = 100)
■ Capacity Utilization (%)
■ Efficiency Gain (%)

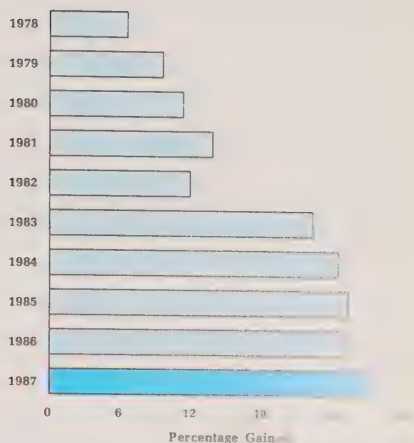
Source: Statistics Canada and Task Force Reports.



Industrial Minerals Industry

Energy Conservation Task Force

John A. Clarke
Chairman



Task Force Description

The Industrial Minerals Energy Conservation Task Force represents nine industry sectors that mine, process and/or manufacture a variety of non-metallic materials and products. The combined Gross Domestic Product (GDP) of these industries amounted to \$9 billion in 1987.

This report covers about 80% of the total industrial minerals energy consumption. The highly energy-intensive abrasives, cement, and glass manufacturing industries are fully represented. Ninety per cent of the asbestos operations are included in the survey result. In the more diversified but less energy-intensive clay and concrete products, lime manufacturing, refractories, and miscellaneous minerals sectors, the survey includes only the largest producers.

General Performance

The group's consolidated energy

efficiency gain was 2% in 1987 — raising the total since 1975 to 27.1%. Individual sector results follow.

Based on an estimated cost of \$432 million for fuel and electricity, 1987's increased efficiencies added some \$9.9 million to the level of previous cost savings achieved by the participating companies. The 1987 savings are generally attributed to a variety of factors, including higher plant outputs and capacity utilizations, a high degree of attention to housekeeping and maintenance, and a small number of energy conservation projects.

Increased production and capacity utilization were the dominant beneficiary factors to the sector's energy efficiencies this year. The 1987 industrial mineral's GDP index rose a tremendous 9.7 percentage points and capacity utilization went up 6.6 percentage points as a result of increased sales in the con-

struction industries. The downturn in the rate of capital investment did not affect 1987 performance and will, in some small measure, impact on future results.

Plant housekeeping and maintenance assumed less importance as industrial minerals operations and production rates were pushed back to high levels. Not only was there opportunity for proper maintenance, but wear and tear occurred more rapidly as process temperatures approach maximum limits. Thus, in spite of the efficiency gains made by additional production, there was undoubtedly significant energy losses caused by higher rates of deterioration in plant equipment, particularly in rotary kilns and melting furnaces where the integrity of insulation systems is important.

Very little efficiency gain came from new or revised projects in this industry. Most of the

nologies employed are very mature and not easy to change because of the large invested capital. However, some exciting possibilities for future process energy savings exist. For example, a new glass melting technique takes place in the burners themselves, but this technology is still in the R&D phase.

Sector Reports

Abrasives

This report covers four companies that make raw aluminum oxide and/or silicon carbide by electro-fusion technologies.

Group efficiency gained 2.3% during 1987 by optimizing raw material blends, further installation of new process controls and some reported process modifications. Close control of electric demand and power remains the main focus of energy conservation in this sector.

Silicon carbide is made by fusing coke and sand together in large donut shaped electric resistance "furnaces". Sacrificial sawdust is placed in the batches to burn in a manner that creates passage for the escaping carbon monoxide gases which then must be burned with natural gas to meet environmental emission standards. The energy intensity of this process varies between 12,000 and 14,000 megajoules per tonne of product, depending on the size and configuration of the furnace. About 88% of the total energy is supplied by electricity and 12% from natural gas for exhaust cleanup. Heat is also captured from the raw material coke but this does not enter into the efficiency calculations.

Raw aluminum oxide is made by fusing chemically purified alumina (Al_2O_3) with fluxing agents and other admixtures in conventional arc furnaces. The electrical intensity of this process is in the 10,000 megajoule per tonne range.

Energy efficiency has always been

a high priority of companies in this sector, as shown by their positioning near the cheap electricity generated at Niagara Falls. But as electricity costs have risen, better operating controls have been installed and refinements to operating procedures have been necessary to keep manufacturing costs to a minimum. Electrical power factors are kept near unity to minimize cost/kWh rates. Power demand is controlled by sophisticated instruments and by careful production scheduling. Operators' skills have also been honed to charge the furnaces in a manner that minimizes the required amount of fusion energy.

It is estimated the group now spends about \$26 million for electricity and fuel but saved an additional \$632,000 during the year from improved conventional energy conservation techniques.

Plasma Extended Arc Reactor (PEAR) technology might be used in this industry in future to replace conventional carbon arc furnaces but development is still in the pilot-plant stage and the economics of a changeover are not yet proven.

Asbestos

The effects of rationalization, plus general productivity efforts, and a minute upturn in volume, led to a 3.5% improvement in energy utilization during 1987. There is considerable variation in energy intensities from the average 6828 megajoules per tonne of processed raw fibre because of the different sizes and locations of each plant. One company is located in British Columbia and the others in Quebec.

It is estimated the industry spent about \$41 million for fuel and electricity during the year, but efficiency gains saved \$627,000.

The British Columbia company uses fuel oil to supply all its energy needs, including generation of electricity for its mill and the town site. In the Quebec companies, 35% of the total energy is supplied by electric-

ity (costing about 3 cents/kWh), 42% from residual fuel oil (at 10 to 13 cents/litre), and the remainder of the total is diesel and gasoline used for site vehicles and miscellaneous plant and maintenance operations. The relative shares of energy have remained the same since monitoring began. Energy costs still amount to about 20% of the total manufacturing costs in this sector.

Cement Manufacturing

The eight Portland cement manufacturers produced 10.4 million equivalent tonnes¹ in 1987 to supply all of Canada's domestic needs plus some clinker and finished cement for export to subsidiary plants in the United States.

Overall efficiency of the group improved 2.8% in 1987 after having experienced a loss of 2% last year.

The average total energy intensity was 4844 megajoules/equivalent tonne, of which fossil fuels supplied 87.4% of the total and electricity 12.6%. Approximately 83% of the total production was made in dry-process plants which operate in the 4583 megajoule/tonne range. Wet-process plants usually require about 6094 megajoules/tonne for operation.

Total cost of fuel and electricity amounted to \$191 million which usually represents about 23% of the total manufacturing costs. The surveyed companies saved approximately \$4.4 million during 1987 on their energy expense, indicating that energy management is indeed an important consideration in cement manufacturing.

¹ An equivalent tonne is a weighted measure of production that accounts for the different energy intensities required to make clinker and cement. Approximately 92% of the total energy required is used to produce clinker. The remaining 8% is used to grind the clinker to produce finished cement. In some plants clinker is exported without being ground.

No particular technical or retrofit projects were cited for the efficiency gains reported. Capacity increases helped in eastern and western plants, but the central plants were already operating at their peaks. Careful scheduling of maintenance shutdowns and maximum production in summer months has helped.

Some major fuel switches have occurred since 1975 in an effort to reduce operating costs. The coal share has increased from 10.8% to 64%, while natural gas use has dropped from 49.5% to 31.6%. The consumption of natural gas was increased during 1987 by 7% as a result of the deregulated natural gas contracts which priced some gas competitively with coal. The full benefit of this change has probably been achieved now that gas prices are starting to firm up and cheaper alternatives, e.g., the possible use of municipal waste, await environmental approval.

Clay Brick, Tile, and Clay Products

Energy utilization improved 2.1% during the year raising the total gain in this sector 29.3% over the 1978 base year level. Based on an estimated fuel and electricity cost of \$16 million among the surveyed companies — which represents about 35% of the total industry usage — increased efficiency saved the participants \$559,000 for use elsewhere.

The energy intensity of fired clay brick now averages 3533 megajoules/tonne (1.8 tonnes/1000 equivalent units) among the participants. However, the energy intensity of clay tile products is often three times this amount because of the great variety of different shapes that cannot be mass produced.

Performance was up again this year primarily from additional increases in volume and capacity utilization throughout the industry. One major Ontario company is now building a new state-of-the-art plant to double its capacity. Other com-

panies report that scheduling more production in summer months helped efficiencies. Several mentioned added benefits from recovery of exhaust heat. Some companies in this industry are also using oxygen-enriched combustion systems to improve furnace efficiencies.

Energy management is an extremely important activity because fuel and electricity costs generally range between 20 to 25% of total manufacturing expenses. Natural gas provides 92.7% of the purchased energy while electricity accounts for 6.8%. Energy now costs about \$27/1000 brick equivalents in most companies while those with discounted natural gas contracts are generally in the \$22/1000 units range.

Concrete Products

The concrete product manufacturers also benefited from increased production and higher capacity utilizations which helped raise the 1987 performance 1.9%. Energy utilization is now 16.2% better than it was in the 1979 base year.

Product energy intensities are variable throughout the surveyed companies because of the different kiln configurations, i.e., autoclaves versus low pressure kilns, different product specifications, and plant sizes. However, the average for concrete block "equivalents" appears to be in the 10,400 kilojoule/unit range.

Electricity normally supplies 10% of the total consumption, diesel fuel and gasoline provide 17% for materials handling and the balance (72%) comes from natural gas for steam boiler fuel.

All of the surveyed companies have benefited from discounted natural gas contracts. Two of the largest companies (not in the survey) buy natural gas on direct "buy/sell" arrangements with even greater cost savings.

Modest energy conservation savings in this low energy intensive industry might come from improvements to the kiln steam heating systems and kilns, but there doesn't appear to be much potential left in the housekeeping and production scheduling category.

Glass

The five companies surveyed in this sector operate 19 large continuous glassmaking plants which produce about 90% of the glass containers, flat glass and fibre insulation used in Canada.

Efficiency in the survey companies dipped slightly by 0.2% as a result of operating plants in a range beyond their optimum efficiency levels. Most plants report full shift schedules with a large backlog of orders. Overall performance is 33.8% better than 1974 operations.

It is estimated fuel and electricity cost \$100.5 million during the year based on an average \$5.36/gigajoule cost factor. Notwithstanding the decreased performance in 1987, the annualized cost savings is in the order of \$2.7 million per year due to past energy conservation and general efficiency improvements. Energy intensities are monitored very closely in the surveyed companies but cannot be revealed because of the intense market competition and single coverage of some product lines.

Most of the industry's energy savings have been achieved by modifications to the glass melting furnaces and accurate control of heat in the different zones of the annealing ovens. In some plants, booster electric heaters have been added to the furnaces to provide direct heat and help agitate the bath for quicker melting. However, it takes about 18 to 24 hours for feed stock (silica, limestone, and sodium carbonate) and cullet to pass through the melting process.

Furnace insulation systems have gradually been improved to reduce heat transfer losses and extend their life up to several years in many cases. There are still major savings possible from better positioning of the burners to increase the radiant and convection heat input into the bath. Some U.S. tests have tried submerged combustion and radically new furnace configurations but these are still in the R&D phase. Additional exhaust heat recovery for preheating cullet and combustion air offer good possibilities for significant efficiency gains. Low excess air burners and combustion control systems have yet to be installed in all the plants.

Lime

Lime manufacturing is accomplished by calcifying quarried and crushed limestone in rotary kilns in a manner similar to the cementmaking process. About 6300 megajoules/tonne is required for production of lime. Energy costs constitute up to 40% of the total manufacturing cost, which is about twice that of basic raw materials.

Energy efficiency improved 1.5% in 1987 and is now 17.3% better than aggregate conditions in 1979. In this sector, efficiency went up somewhat with increased production and capacity utilization resulting from very good sales to the steel industry — the lime industry's major market. Performance was also improved by one company's new computerized kiln burner control system and another's total overhaul of its plant electrical system.

Natural gas is the most suitable fuel since it produces high purity lime products as required by the steel industry. Natural gas provides 56% of the total energy consumption. Coal and coke supply 42% and electricity constitutes only 2% of the total energy.

Miscellaneous Minerals

This sector produces a variety of materials such as silica sand for the glass industry, roofing granules, nepheline, sodium sulphate, and talc and raw crushed limestone for the chemical industry. Many of these processes require extensive crushing or pulverizing, milling, refinement, drying and grading before shipment.

Energy budgets are generally large and range between 5 and 15% of production costs. In these operations the energy balance is usually 20% from electricity, 73% for heating and drying (mostly from natural gas), and the remainder for diesel and gasoline for plant vehicles.

Energy management has become a more important issue because of rising processing costs. Changes are being made in production procedures, economizers are being installed on heaters and dryers, and steps are being taken to control electrical demand for greater efficiency. The group's improvement was 3% in 1987, which helped save the participants \$380,000 on their aggregate fuel and electrical bill of \$27 million.

Refractories

A clear indication of performance trends was unavailable in this small group this year because of significant changes in the reporting population, a change to more energy intensive products in one company, and a general move in others toward less energy intensive products. Partly because of these trends, some of the companies were reluctant to participate in the survey.

It is known, however, that companies are making concerted efforts to identify and improve their operations by having new technical audits done, following up with investment in new equipment. Previous reports show average fired product energy intensities in the 6500 megajoule/tonne range and energy costs up to

12% of the manufacturing expenses. These factors usually mean that energy management is a closely monitored activity.

Future Outlook

The 1990 efficiency target of 35% (compared with 1975 energy intensities) will probably be achieved because of the increasing importance of energy management throughout the non-metallic minerals industry. The priority is increasing once more now that utility cost rate structures are changing and noticeably affecting the costs of some companies in this industry. For example, Ontario Hydro is planning to introduce "time-of-use" rate structures in 1989 that will penalize high load factor users who may have little opportunity to shift production to off-peak periods. What's more, minimum natural gas prices have probably been reached and are expected to rise again.

In view of these rising utility costs and the increased competition in the market place, companies will be shifting the emphasis back to productivity programs as a means of profit improvement.

Industrial Minerals Industry Energy Efficiency Improvement

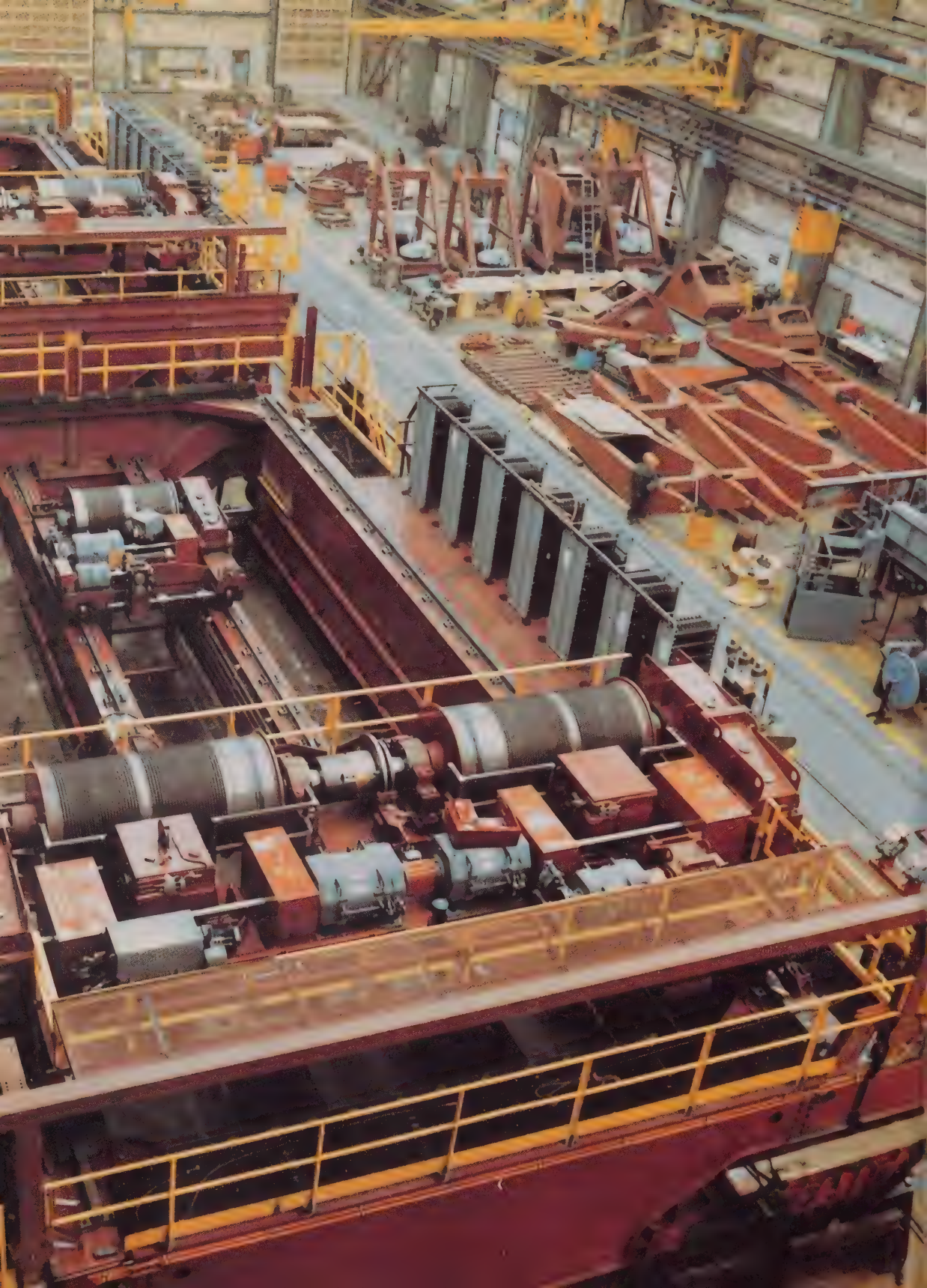
Current year (1987) total energy inputs	91.262 petajoules
New base year (1985) equivalent energy inputs	92.855 petajoules
Net Improvement = 1.7%	
Efficiency gain 1975 - 1985	25.4
1986	-0.3
1987	2.0
Total gain 1975 - 1987	27.1%

Industrial Minerals Industry Energy Use

Type	Units	Petajoules	Percentage of Total Consumed		
			1987	1986	1985
Natural Gas	1,047,850 m ³	38.980	42.7	40.1	42.6
Electricity	3,921,892 MWh	14.119	15.5	15.7	15.6
Liquid Petroleum Products					
Distillate Oil	14,471 kilolitres	0.564	0.6	0.7	1.2
Residual Oil	89,253 kilolitres	3.615	3.9	4.2	5.1
Diesel and Gasoline	46,004 kilolitres	1.825	2.0	2.0	2.2
Coal	9,665,736 tonnes	31.028	34.0	36.6	32.4
Other Fuels					
Propane and LP Gas	8,587 kilolitres	0.228	0.2	0.3	0.2
Steam	n/a	0.903	1.0	0.4	0.5
Totals	1987	91.262			
	1986	82.632			
	1985	80.081			
	1984	79.213			
	1983	74.291			
	1982	84.229			
	1981	100.403			
	1980	98.615			

Industrial Minerals Industry Energy Consumption

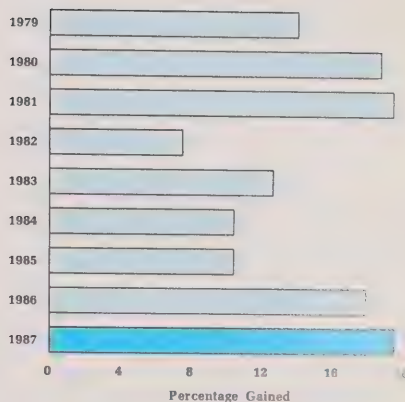
Sector	1987 Consumption Petajoules	1987 Efficiency Gain (%)	Total Efficiency Gain (%)	Base Year
Abrasives	2.363	2.33	11.3	1982
Asbestos	4.613	3.54	12.0	1979
Cement	50.480	2.81	27.1	1974
Clay Brick	3.674	2.08	29.3	1978
Concrete Products	0.694	1.92	16.2	1979
Glass	18.484	-0.21	33.8	1974
Lime	5.258	1.50	17.3	1979
Miscellaneous	4.721	2.99	13.7	1977
Refractories	0.975	-0.71	10.4	1975
Totals	91.262	1.99	27.1	1975



Machinery Industry

Energy Conservation Task Force

Frank A. Hlohovsky
Chairman



Task Force Description

The Machinery Industry Task Force represents approximately 130 firms engaged in the production of a wide range of industrial machinery and equipment used by Canada's resource, processing, manufacturing and service industries. The industry's typical products are mining equipment, pulp and paper machinery, pumps, cranes, gears, etc.

The activities of the task force are co-ordinated by the Energy Conservation Committee of the Machinery and Equipment Manufacturers' Association of Canada (MEMAC). The very large variation in energy consumption by member companies hampers a common approach to energy management.

The large energy users have programs that stress energy efficiency in their manufacturing processes as well as in the machinery and equipment that they market. Smaller firms wish to dialogue on energy con-

servation matters.

Thirty-one firms responded to the 1987 survey for a participation rate of 30%, slightly better than the rate in 1986. Energy management awareness appears to be the major contributing factor.

General Performance and Progress

Results from the 1987 survey show an improvement of 9.4% over the revised 1985 base year. The aggregate improvement since 1975 is 19.8%. Savings as a result of conservation from 1985 to 1987 were \$449,023.

In Ontario and Quebec, firms are taking advantage of energy conservation programs offered by the provinces. A firm that utilized the energy audit services of the Quebec Energy Bureau identified potential savings of \$100,000 or 26% of total energy costs. On implementation, the savings were even higher.

Improvements to energy efficiency are expected to continue as firms invest in capital equipment which has the latest technological innovations. The resource industries in particular are demanding machinery and equipment with improved energy design. Furthermore, government programs, both federal and provincial, are placing renewed emphasis on energy conservation throughout the entire industrial environment.

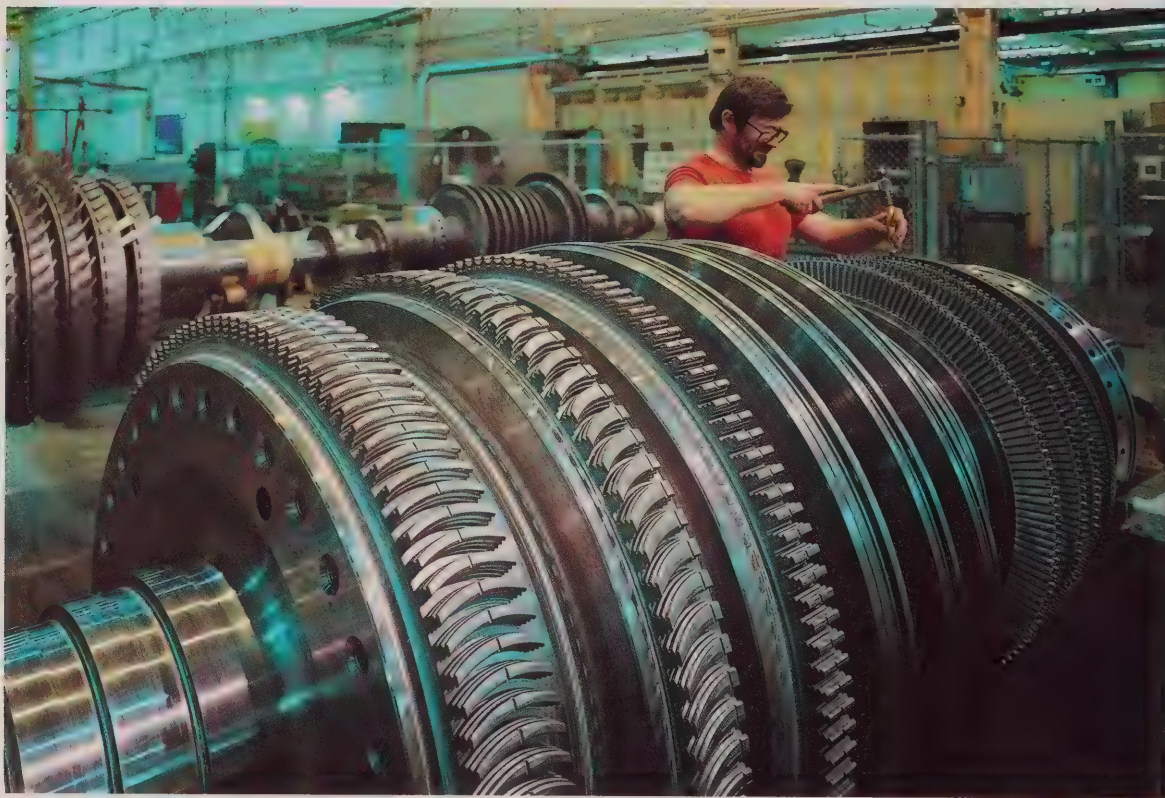
Task Force Activities

The task force continues to monitor and publicize energy conservation developments to members. In many instances, because some member firms have low energy consumption rates, it is difficult to implement and sustain dedicated energy conservation programs.

The challenge for the coming year will be to increase the number of firms that have clearly defined pro-

grams and support the task force in its various activities. A weakness has been identified in the research and development process for energy conservation. While there are many government programs stressing energy conservation, there is no central agency which identifies, coordinates or implements improved energy design in machinery and equipment. As with other research and development in Canada, there

appears to be a lack of linkage in what is being done in government research laboratories or agencies and what industry is demanding. An attempt will be made to identify research and development establishments where member firms may receive assistance in the design of energy efficient machinery and equipment.



Machinery Industry Energy Efficiency Improvement

Current year (1987) total energy inputs	566,274 gigajoules
New base year (1985) equivalent energy inputs	625,356 gigajoules

Net Improvement = 9.4%

Adjustments — None

Efficiency gain 1975 - 1985	10.4
1986	7.5
1987	1.9
	19.8%
Total gain 1975 - 1987	19.8%

Machinery Industry Energy Use

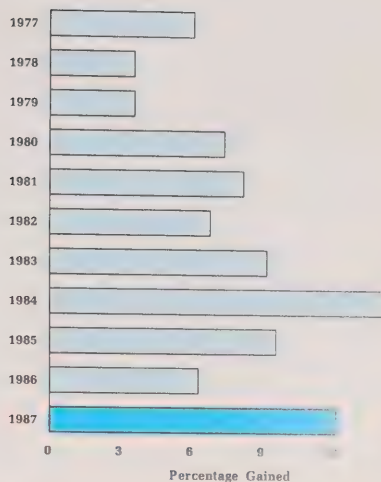
<u>Type</u>	<u>Units</u>	<u>Gigajoules</u>	<u>Percentage of Total Consumed</u>	
			<u>1987</u>	<u>1985</u>
Natural Gas	8,294,040 m ³	308,538	54.5	53.1
Electricity	59,853,686 kWh	215,473	38.1	37.4
Liquid Petroleum Products				
Distillate Oil	753,465 litres	29,385	5.2	5.0
Crude Oil	40,000 litres	1,608	0.3	0.3
Gasoline	185,912 litres	6,730	1.2	1.2
Other Fuels				
Propane and LPG	3,125 kilograms 164,763 litres	} 4,540	0.8	0.8
Total		566,274		



Mining and Metallurgy Industry

Energy Conservation Task Force

Raynald Fournier
Chairman



Task Force Description

The Mining and Metallurgy Energy Conservation Task Force was organized in 1975 and is operated under the auspices of the Mining Association of Canada (MAC). Its membership includes major Canadian producers of metals including iron, copper, nickel, lead, zinc, gold, silver, aluminum and molybdenum. Producers of uranium, oil sand and fertilizer are also represented. The types of processes used include mining, milling, smelting, refining, indurating and fertilizer production.

A total of 13 companies participated in the 1987 survey, an increase of four over the previous year. One major new reporting company is the largest company now submitting data. The 13 companies reporting represent over 26 mine sites or 80 to 85% of the total mining industry.

Most companies reported using 1985 as the base year.

Activities of the task force are directed through an annually elected chairman and co-ordinated by an executive secretary contracted to carry out task force initiatives. For 1987, the chairman was Raynald Fournier of Quebec Cartier Mining Company, with Marilyn Culver providing executive secretary services in the MAC office.

Performance and Progress

Energy consumption per unit of production showed a negative trend from 1984 to 1986, caused by falling energy prices. This trend has been reversed with an improvement of 2.7% in 1987.

From 1973 to 1985 there was an improvement of 9.6%. From 1985 to 1987 the figure is 2.7% for a total of 12.3% at the end of 1987. The goal from 1985 to 1990 is an improvement of 15%.

Total energy used in 1987 by reporting members was 133,146 terajoules. This is equivalent to the energy content of 21.7 million barrels of crude oil. The energy saved was 8,194 terajoules, equivalent to 1.4 million barrels of oil. The total adjustments for industry performance were 304 terajoules. The weather in 1987 was warmer than in 1985 and this factor accounted for all adjustments.

Energy Use Patterns

In 1987 electricity represented 34.2% of energy usage.

Natural gas which has been replacing petroleum accounted for 18.4%. Petroleum accounted for 16.0% of energy used. Coal and coke have also replaced oil in some areas and together account for 8.4% of energy usage.

A category classified as "other" included hot water at 1.4%.

at 7.4%, naphtha at 0.2% and propane at 0.6%. A major portion of energy consumption reported by the new participating company fell in this category. For this reason percentages changed drastically from the previous year.

The graph illustrates the historical distribution of energy between the years 1979 and 1987.

Task Force Activities

During 1987, the task force held two general technical meetings to exchange information on energy management. One of these meetings was hosted by a member company, Brunswick Mining & Smelting Co. in Bathurst, N.B., and a tour of their

facilities followed. The other was held in Ottawa in conjunction with the annual meeting of the Mining Association of Canada.

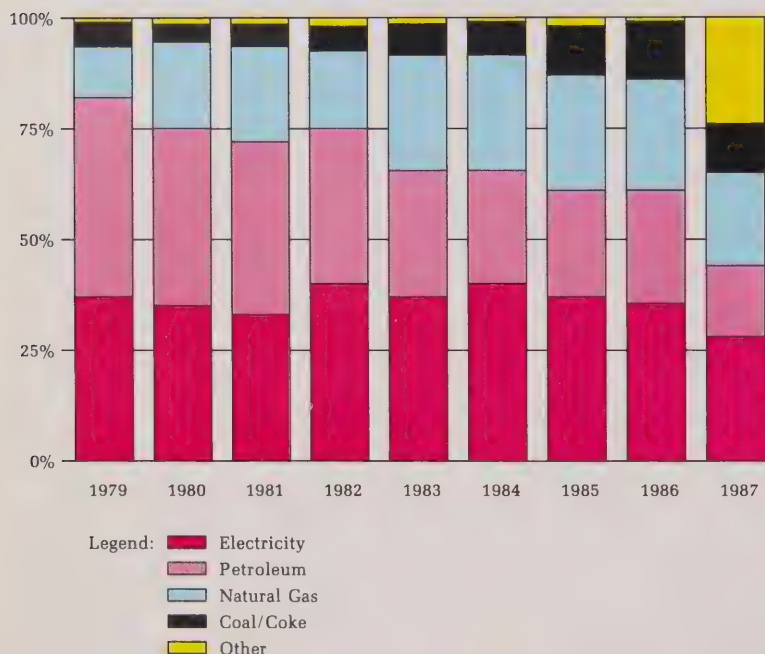
The task force maintains a "Manual of Case Histories" describing energy management activities undertaken by member companies. This manual is currently being updated. Abstracts are being written and a computerized index is being developed. New case histories will be published in the CIPEC newsletter as they become available.

Future Outlook

The program objectives of this task force will be broadened to keep pace with the changing energy management scene by:

- Increasing our involvement with the provincial energy ministries and federal department of Energy, Mines and Resources.
- Increasing membership and the number of companies reporting annual energy consumption statistics.
- Investigating further the issue of changing energy use by focusing particularly on energy intensities as they relate to other OECD countries.
- Orienting the task force toward a greater emphasis on technical activities.

**Mining and Metallurgy Industry
Historical Energy Distribution**



Mining and Metallurgy Industry Energy Efficiency Improvement

Current year (1987) total energy inputs	133,146 terajoules
New base year (1985) equivalent energy inputs	141,340 terajoules
Gross Improvement = 5.79%	
Adjustments	304 terajoules
Adjusted base year equivalent	141,644 terajoules
Net Improvement = 6.0%	
Efficiency gain 1973 - 1985	9.6
1986	-3.3
1987	6.0
Total gain 1973 - 1987	12.3%

Mining and Metallurgy Industry Energy Use

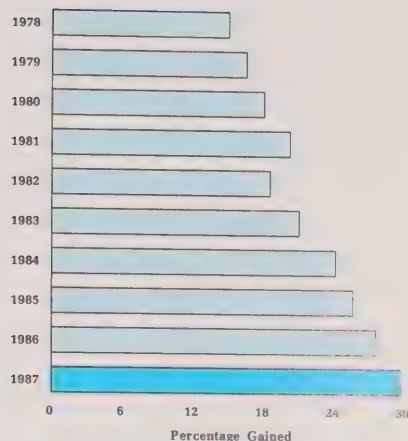
<u>Type</u>	<u>Units</u>	<u>Terajoules</u>	<u>Percentage of Total Consumed</u>
Natural Gas	656,860,215 m ³	24,435	18.4
Electricity	12,656,944 MWh	45,565	34.2
Liquid Petroleum Products			
Distillate Oil	24,228 kilolitres	945	0.7
Residual Oil	305,007 kilolitres	12,353	9.3
Crude Oil	529,551 kilolitres	22,400	16.8
Diesel	19,054 kilolitres	7,603	5.7
Gasoline	9,097 kilolitres	329	0.2
Coal	168,853 tonnes	5,420	4.1
Coke	247,133 tonnes	5,758	4.3
Other Fuels			
Propane	308,722 kilolitres	821	0.6
Others (hot water, steam)	n/a	7,517	5.7
Total		133,146	



Petroleum Refining Industry

Energy Conservation Task Force

Glen G. Myers
Chairman



The Petroleum Refining Industry Task Force established in 1977 continues to report on energy conservation progress in its sector. This report for 1987 is based on submissions from 10 companies which process in total about 90% of the crude oil upgraded and refined in Canada.

Major changes in the industry and in the energy monitoring facilities in use have made it necessary to adopt a more recent base year to accurately quantify recent improvements in energy consumption. The year 1985 has been selected as the new reference.

Energy Efficiency Improvement Progress

In 1987, the petroleum refining industry achieved a 4.9% net reduction in energy consumption relative to 1985. This energy reduction has been added to the 25.6% reduction achieved earlier during the period between the original base year

(1972) and the new base year to show a consolidated gain of 30.5%, surpassing the 1990 goal of 30%.

The improvement was achieved in the face of a steady increase in processing intensity resulting from such factors as continued lead phasedown, increased product desulphurization requirements and further product mix changes. Without adjustment to equivalent 1985 operating conditions, the reduction achieved since 1985 was 3.5%.

Economic Factors Affecting the Industry

Most of the major energy conservation projects derived from process studies conducted in the early 1980's were completed by the end of 1987 and only a few large projects offering rapid returns on the investment are planned for implementation in the near future. Continued volatility in crude oil and product prices is complicating investment decisions

regarding energy conservation and other projects. Until refining margins improve further, additional reductions in energy use will likely come from small investment projects and improvements in control and optimization of present facilities.

Any additional processing facilities needed to meet new government regulations will be designed for high energy efficiency, but will consume some additional energy and will limit the funding available for other projects, including energy conservation projects.

Specific Conservation Activities

1. Operations and Maintenance

The reduction in energy use achieved in 1987 resulted partly from recently completed projects, and partly from continuing improvement in operations and maintenance practices.

conservation equipment installed in the mid-1980's reached the time of requiring additional maintenance and tuning. Areas of improvement included:

- Close attention to process settings by operators, supervisors, engineers and management.
- Increased direct responsibility for achieving conservation goals assigned to operators and maintenance workers.
- Continued emphasis on training operators and engineers.
- Increased furnace efficiency through combustion control improvements.
- Continued commitment to timely repair of steam leaks, damaged insulation, steam traps, etc., and to heat exchanger cleaning.
- Optimization of steam systems.
- Improvements in energy monitoring and control techniques.
- Application of process optimization techniques.

2. Capital Projects

Some capital investment in energy conservation work occurred in 1987, primarily in the following areas, with close attention paid to achievement of project goals:

- Heat recovery facilities, particularly in crude heat exchangers.
- Improvements in plant automation and control.
- Insulation upgrading.
- Reduction in steam consumption.
- Modifications to raise furnace and boiler efficiencies.
- Facilities to reduce fuel gas production.

3. Technology Improvements

Recent gains in energy efficiency have come partly through application of some of the latest advances in technology. The processes used to upgrade and refine

crude oil are complex and the improvements easiest to implement were among the first to be installed. Accordingly, the industry has a strong interest in applied research and development to attain higher process efficiency. The industry maintains close relations with scientific and technology research activities worldwide. The types of new technology undergoing rapid development and application include:

- Improved catalysts and additives.
- Facilities to reduce crude oil and product losses.
- New techniques to increase heat recovery.
- Techniques to convert fuel gas components into liquids.
- Advanced computer control and process optimization techniques.
- Sophisticated data management systems.
- Use of high efficiency electric motors.
- Facilities for plantwide monitoring and control of electrical power.
- New types of on-line analyzers.
- Flare gas measurement and recovery.

Task Force Activities

The petroleum industry task force is led by two committees: a Steering Committee which sets policy, maintains government relations and establishes funding, and a Technical Committee which reviews industry reporting procedures, receives composite industry data and prepares the annual sector report. The Steering Committee is chaired by G.G. Myers, and the Technical Committee is chaired by N.J. Little.

To protect the confidentiality of data from individual sources, the offices and secretarial services of PACE (The Petroleum Association for Conservation of the Canadian Environment) are used to obtain and

consolidate the technical data submitted by the participating refining companies. It should be noted that all costs involved in the activities of the task force are borne by the petroleum refining industry.

The sector does not consider itself as suitable to sponsor or conduct educational workshops. However, member companies are encouraged to participate individually in academic and industrial seminars on energy management and conservation.

Future Outlook

Improvements in operating and maintenance practices and implementation of small capital projects applying recent technological advances will continue to receive the strongest emphasis in the near term, and should yield appreciable additional improvements in energy use. In Ontario, introduction of time-of-use electricity rates will force development of steps to shift some electrical loads to the low-cost nighttime period.

In the longer term, larger capital expenditures will be required to make further significant progress in energy efficiency in petroleum refining. The investments will proceed if expected rates of return are adequate and capital funds are available. The highly competitive nature of the industry and the need to remain competitive will likely spur the drive toward higher energy efficiency.

Applied Conversion Factors

Crude Oil	37.660 GJ/m ³
Distillate	38.655 GJ/m ³
Residual	41.721 GJ/m ³
LPG	26.617 GJ/m ³
Natural Gas	38.414 MJ/m
Refinery Gas	36.886 MJ/m
Petroleum Coke	35.030 MJ/kg
Coal	27.935 MJ/kg
Purchased Steam	2.791 MJ/kg
Purchased electricity	10.551 MJ/kWh

Petroleum Refining Industry

Energy Use

Type	Petajoules	Percentage of Total Consumed
Natural Gas	52.1	17.8
Electricity (purchased) (a)	38.9	13.3
Liquid Petroleum Products		
Distillate Oil	0.3	0.1
Residual Oil	11.7	4.0
Petroleum Coke	58.0	19.8
Other Fuels		
L.P. Gas	2.6	0.9
Refinery Gas	127.0	43.4
Steam (purchased)	2.0	0.7
Total	292.6	

Energy based on (1) company assigned conversion values,
(2) measured thermal values, or (3) U.S. Bureau of Mines

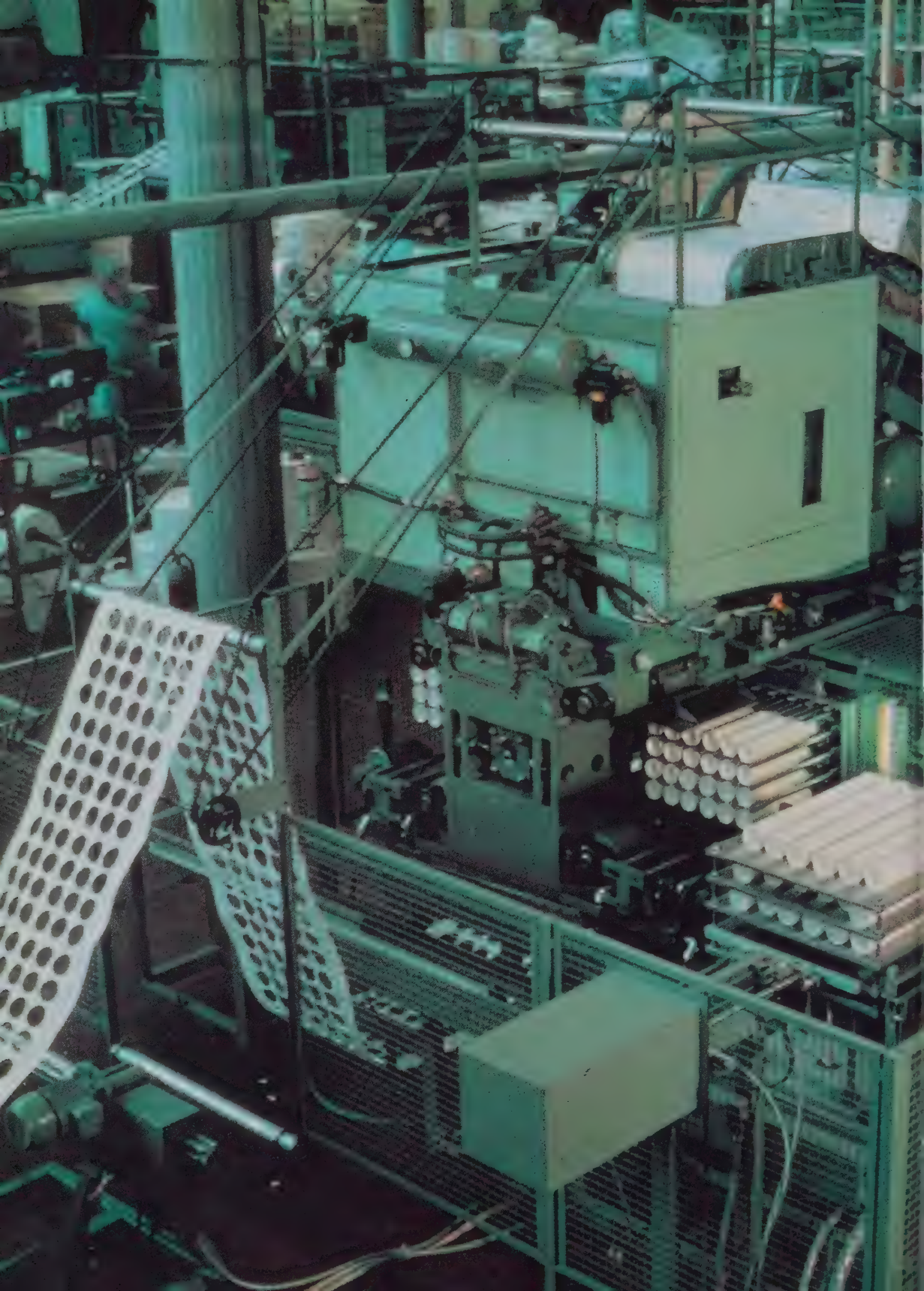
Energy Efficiency Improvement

Current year (1987)	
total energy inputs	292.6 petajoules
New base year (1985)	
equivalent energy inputs	303.3 petajoules
Gross Improvement =	3.5%
Adjustments (for increased processing severity, changes in product mix, capacity utilization, etc.)	4.4 petajoules
Adjusted base year equivalent	307.7 petajoules
Net Improvement =	4.9%
Efficiency gain 1972 - 1985	25.6%
1986	2.0
1987	2.9
Total gain 1972 - 1987	30.5%

Composite Report for 10 Companies January through December 1987

Line	MJ/m ³ Input
1. Total measured energy consumption, current reporting period	3,411
2. Processing adjustments ¹	-
3. Lead phaseout and higher clear mogas octane	13
4. Increased desulphurization (tighter product specs and lower crude quality)	14
5. Product mix changes	10
6. Other processing adjustments	-3
7. Major capacity additions	-1
8. Processing of liquid, gaseous, and solid wastes	1
9. Throughput effect	-4
10. Miscellaneous	22
11. Total adjustments (sum of lines 2-10)	52
12. Current operations adjusted to operating conditions (line 1 minus line 11)	3,361
13. 1985 base period — total energy consumption	3,537
14. Energy conserved in reporting period based on conservation steps implemented since 1985 (line 13 minus line 12)	176
15. Per cent change from 1985 base period	4.9
16. Total refinery input, 1985 base period	226.4 10 ³ m ³ /d
17. Total refinery input, current reporting period	234.9 10 ³ m ³ /d

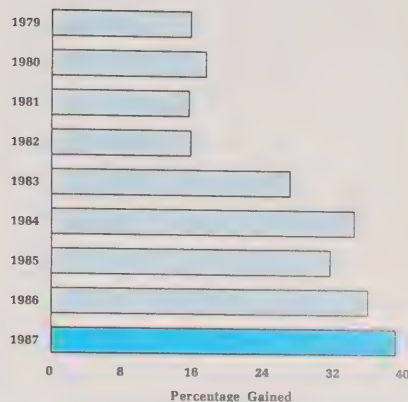
¹ Use calculated adjustment factors or Nelson complexity index of $\Delta 1 = 498 \text{ MJ/m}^3$



Plastics Processing Industry

Energy Conservation Task Force

Ron S. Hayter
Chairman



This report is based on a survey of the processing sector of The Society of the Plastics Industry (SPI) of Canada, which represents companies engaged in all facets of the industry.

Plastics is now the fourth largest manufacturing industry in Canada with some 78,000 employees, and a Gross Domestic Product (GDP) of \$10.1 billion. Its high GDP growth rate — 9.1 percentage points in 1987 — is due primarily to the cost-effectiveness and versatility of plastics. Some of the benefits inherent in its production, however, are the low energy requirements for manufacture of a variety of highly specialized products and very efficient processing operations.

The companies represented by this survey are independent, high-volume processors utilizing the injection moulding, extrusion, blow moulding, fabric coating, and reinforced layup methods of manufac-

ture. Raw material suppliers, distribution companies, and equipment makers are not included in the survey because of their totally different energy requirements. A large number of captive processors have also been omitted since their performance is incorporated in their parent organization's report to other task forces.

Three-quarters of the reporting companies show energy costs in the \$100,000 to \$500,000 range. In these firms, energy management is usually one of the many tasks performed by local plant managers or central operations managers. Energy monitoring is normally done as part of factory cost accounting on a monthly schedule.

One-quarter of the companies in the survey spend between \$1 million and \$2 million for fuel and electricity. These companies often have plant engineers dedicated to the task of improving operating efficiencies

and controlling costs with the aid of computerized energy monitoring systems.

In general, productivity management throughout the plastics processing industry tends to be a "hands-on" entrepreneurial activity. As such, managers are attentive to up-to-date production and energy conservation techniques and tend to make decisions quickly, based on their knowledge of successes elsewhere in the industry.

Energy Performance

Energy utilization in the surveyed companies improved 3.6% in 1987, raising the overall gain since 1980¹ to 39.5%. At the current rate of im-

¹ Even though the Plastics Processing Energy Conservation Task Force was established in 1976, the consolidated reference time has gradually shifted up to 1980 as a result of constant changes in products.

provement the 50% goal set for 1990 should be achieved on schedule.

In 1987, it is estimated the 42 participants spent \$11.9 million for electricity, while \$4.7 million was spent for natural gas. Because of the improvement in energy utilization, the participants saved over \$1 million in manufacturing expense during the year. This will most likely go towards expansion of their businesses.

Energy costs generally vary between 9 to 12% of total manufacturing expenses in the extrusion and blow moulding processes. The energy intensities and costs are somewhat lower in the filmmaking and coating sectors, however, where percentages between 2 and 6% were reported.

Factors Impacting on 1987 Performance

Business conditions were excellent throughout the industry in 1987. There was a 9.1 percentage point increase in GDP, continued operation at full capacity, and investment of some \$382 million for new plants and equipment. In the past, when such buoyant operating conditions prevailed, energy efficiency gained in the 5.6 to 5.9% range.

In 1987, however, because of the widespread expansion activities and extremely busy staff, many of the usual participants could not take part in this year's survey. As a result, the 3.6% gain reflects a different mix of somewhat smaller companies, many of whom are reporting for the first time.

One of the most frequently mentioned energy conservation improvements again this year was the recovery of waste exhaust heat. For many companies this has meant installing recuperators in the boiler stacks. For others, it involved collecting heat from process equipment

and ducting it into adjoining plant locations. However, a few companies reported that even after these improvements were made they still have a surplus of heat that must be exhausted.

Another common energy conservation action is the installation of electrical-demand-limiting controls and power-factor-correction equipment. These techniques are popular in the injection and blow moulding businesses where the pulsing types of machines cause variable demands for power. One company also mentioned that it made extensive revisions to its air compressor system to lower the electrical power requirement.

More generally, companies have increased productivity by installing state-of-the-art equipment in their plants. The benefits achieved from innovative R&D on new mould designs, raw material preheating systems, compounding and alloying of new materials, and statistical quality control methods, etc., have led to longer production runs and higher product standards.

The trend toward dedication of products exclusively to new highly automated plants or in rationalized locations is continuing to add exceptional efficiency gains for some companies. In these cases, there is frequently less raw material and finished product handling which minimizes warehousing requirements.

A surprising number of comments arose this year from energy managers' growing attention to electrical matters. For example, several mentioned problems with line voltage dips, "spikes", and harmonics, which are triggering more frequent shutdowns of sensitive production equipment, costly production losses and sometimes damage to computerized controls. Others expressed displeasure with high demand charges and the monopolistic attitudes emanating from their elec-

trical utilities. In contrast, these energy managers are pleased with the results of deregulated natural gas prices and the consequent competitive spirit.

Future Outlook

With steady growth in product demand, continued high levels of investment in modern equipment, aggressive application of leading-edge technologies, and maturing energy management techniques, the future of still greater unit-energy savings is exceedingly bright. However, accelerating energy prices and changing utility cost structures, e.g., introduction of electrical "time-of-use" rates, will intensify the need to focus more attention on energy management issues in order to maintain a competitive advantage.

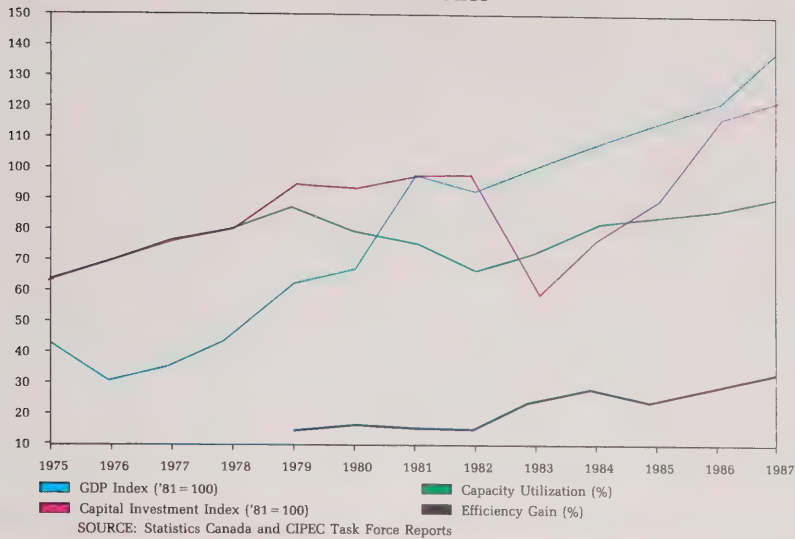
Energy Use Patterns

Minor variations in the shares of purchased energy are caused more by changes in the reporting population than by fuel switching or technological factors. Most plastic processing companies are centred around the large urban centres where natural gas is well established as the most convenient and economical source of fuel for plant heating.

A few companies located near Montreal are known to have switched to electric radiant heating for their plants as a result of attractive incentives provided by Hydro-Quebec, but these isolated cases are not evident in the group trends.

In the Ontario locations, large cost savings have been realized through competitive marketing of deregulated natural gas which has helped drive down prices of other fuels as well. However, there was no detectable fuel switching in 1987 as a result.

Plastics Processing Industry Performance



Plastics Processing Industry Energy Efficiency Improvement

Current year (1987) total energy inputs 2,096.1 terajoules

New base year (1985) equivalent energy inputs 2,278.2 terajoules

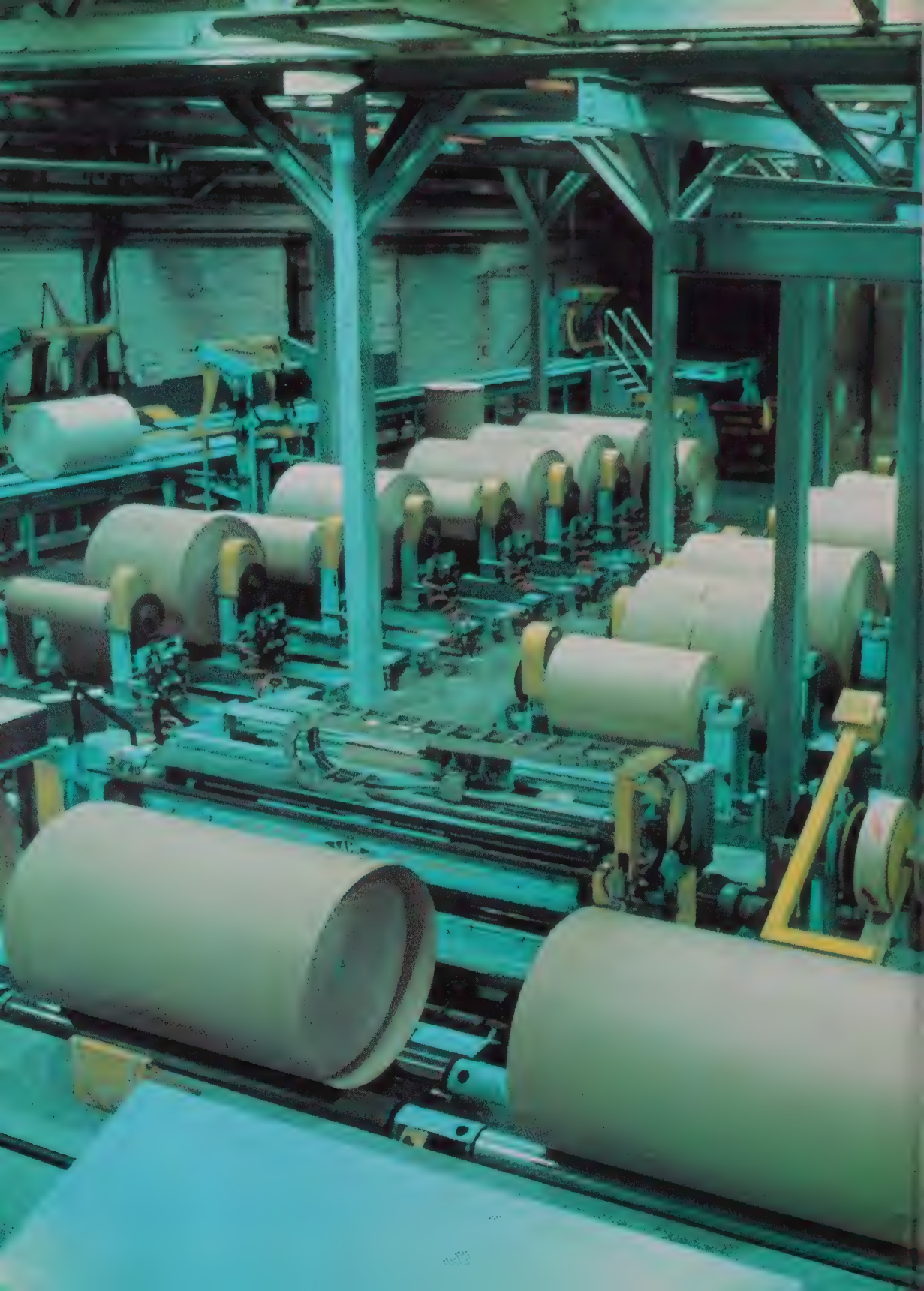
Net Improvement = 8%

Adjustments — None

Efficiency gain 1980 - 1985	31.5
1986	4.4
1987	3.6
Total gain 1980 - 1987	39.5%

Plastics Processing Industry Energy Use

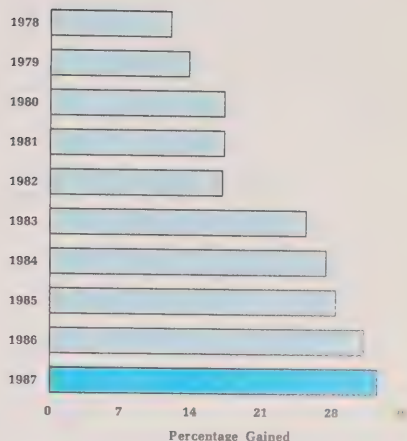
Type	Units	Terajoules	Percentage of Total Consumed			
			1987	1986	1983	1982
Natural Gas	26,589,180 m ³	989.1	47.2	53.0	49.8	53.9
Electricity	288,326 MWh	1,037.9	49.5	42.5	48.8	43.5
Liquid Petroleum Products						
Distillate Oil	241,139 litres	9.4	0.5	1.0	0.6	1.3
Residual Oil	1,097,027 litres	44.4	2.1	3.0	0.4	—
Diesel and Gasoline	136,154 litres	5.4	0.3	0.2	—	—
Other Fuels						
Propane	371,903 litres	9.9	0.4	0.3	0.4	1.3
Total		2,096.1				



Pulp and Paper Industry

Energy Conservation Task Force

H. Dave Paavila
Chairman



Sector Description

The Canadian Pulp and Paper Association's Energy Monitoring Report covers 61 companies with 126 mills accounting for about 98% of the total pulp, paper and paperboard produced in Canada in 1987. Five of the mills included in the report are not members of the Association.

Energy Use Efficiency

In 1987, the Canadian pulp and paper industry used 33.1% less purchased energy per ton of product than was used in the base year 1972. This continuing improvement in energy use efficiency is in part attributable to the record operating rate achieved by the industry in the year. Production increased by 34.1% over the base year.

The trend in diminishing reliance on fossil fuels reported in last year's report continues. The major energy

source is still purchased electricity which accounts for 47.9% of the total purchased energy. Heavy fuel oil has shrunk to 21.6% of the total, which is 29% of the amount used on an equivalent production basis in 1972. On a unit energy basis, electricity increased due to electric boilers in Quebec and increased motive power requirements of mechanical pulping processes which are gradually replacing sulphite pulps, especially in the newsprint sector.

The reduction in heavy fuel oil use is equivalent to 3.98 billion litres, and in total purchased energy use is equivalent to 3.78 billion litres of heavy fuel, in 1987.

Operating Conditions

As noted above, production for the year 1987 was a record one for the industry. Shipments of pulp and paper by the Canadian industry rose by 5% over 1986, with printing, writing and sanitary grades showing the

largest increase. The industry as a whole operated at 98% of capacity for the year, with only small losses of production due to work stoppages. Accompanying this increased output, profits also improved. However, given the large number of projects for modernization, productivity improvement and quality improvement, and more fossil fuel price increases which are currently applicable, energy conservation projects will continue to be given lower priority than in the late 1970's.

Use of wood wastes generated by the industry levelled off during the past year and now account for 68% of the total fuels burned by the industry. Waste fuels plus captive hydraulic power account for 57% of the total energy used, up from 42% in 1972.

Technological Developments

The Thunder Bay, Ontario, mill of Great Lakes Forest Products Limited

was awarded CPPA's Technical Section Energy Conservation Opportunity Award in 1987. Steam leakages through pressure reducing valves, totalling 26,000 lbs./hour, were identified using a computer program that calculates the mass balance in the news mill steam supply system. Because not all flow meters are provided with pressure reducing valves, the leakages were identified inferentially. The mass balance program, which was developed as a joint venture between Great Lakes Forest Products Limited and Fleming Systems Corporation, is run daily to verify the operation of the turbines and bypass systems. For an identical process steam demand, an increase in electrical generation of one megawatt was realized for a monthly saving of about \$23,000. The cost of the software development was approximately \$10,000.

The Technical Section's Energy Conservation Awards Program has now generated a total of 379 case studies, which have been published for distribution throughout the Canadian industry.

In a project funded by Environment Canada, the technical and economic feasibility of drying pulp and paper mill sludges was assessed by PAPRICAN. A literature survey indicated that several recent generation screw presses are only capable of dewatering a variety of pulp and paper mill sludges to 40-50% dryness. Because of this limitation, efficient drying techniques are being investigated.

One such technique which appears to be promising is direct drying with oil as the heat transfer medium and vapour recompression as the source of heat. The concept has been proven on full-scale with secondary pulp mill sludge. Furthermore, the concept has been technically proven at PAPRICAN on a pilot scale with hog fuel.

A conceptual adaptation of the oil-drying process for primary news-

print mill sludge was provided outlining the major equipment required to carry out the process. Detailed capital and operating cost saving estimates were derived for newsprint mill sizes of 330, 660, 1000 and 1300 tonnes per day (t/d). The total capital investment, including installation but excluding a new building or shelter, was approximately \$1.1, \$1.5, \$2.0 and \$2.3 million respectively for the above mill sizes. The net operating cost savings are a result of oil savings from additional steam production from the dried sludge, and savings on disposal of sludge as land fill.

Profitability analysis of the process was carried out by calculating the discounted-cash-flow rate-of-return (DCF-ROR) at various oil prices and sludge disposal costs. At a typical sludge disposal cost of \$30/odt sludge and the presently prevailing oil price of approximately \$25 CDN/barrel (\$19 US/barrel) for newsprint mills of over 660 t/d capacity, the estimated payback period would be three to four years with an after-tax DCF-ROR of 17 to 25%. At only 20% higher oil prices, i.e. \$30 CDN/barrel, the payback period improves to two to three years. In a partly government-funded project, also at PAPRICAN, the use of heat pumps for waste heat recovery in the pulp and paper industry has been studied.

While, in general, there is vast potential for the application of a high

temperature heat pump (HTHP) in a variety of pulp and paper making operations, the actual application is mill specific. In an integrated mill with a high degree of recycle, it requires simulation of the whole mill. It often requires modifying the mill in order to get higher heat pump source temperatures. Steam produced by a HTHP, besides requiring to be an economical operation, must be justified with respect to end-use and other potential heat recovery schemes, such as a heat exchanger network.

Economic evaluations on five R114 HTHPs were performed. Two Canadian Stone Groundwood SGW-based newsprint mills were studied and the potential for installing a R114 HTHP with subsequent steam compression with a heat capacity of over 40 GJ/h was assessed. In the first case, a R114 HTHP coupled to a mechanical steam compressor gave a payback period of 6.6 years and an after-tax discounted-cash-flow return-on-investment (DCF-ROI) of 9.7%. The mill was not typical since it had cogeneration and this precluded the use of high pressure steam to be used in a steam jet thermocompressor. In a second case study, the mechanical steam compressor could be replaced with a steam jet thermocompressor. The economic returns were substantially improved to a 4.2 years payback period and 15.7% DCF-ROI.

Pulp and Paper Industry Energy Efficiency Improvement

Current year (1987) total energy inputs	318.98 petajoules
Base year (1972) equivalent energy inputs	477.18 petajoules
Net Improvement	= 33.1%
Adjustments — None	
Efficiency gain 1972 - 1985	28.3
1986	2.8
1987	2.0
Total gain 1972 - 1987	33.1%

In the case of the kraft mill, the end-use had a temperature low enough not to require the use of a steam compressor. A typical bleach plant operation was described and, similar to the SGW-based newsprint mills, it was found that the application of a R114 HTHP was more favourable with higher degree of closure. The DCF-ROI was 11.9% and the payback period 5.5 years.

The kraft digester blow heat study yielded the best results. The payback period was 3.5 years and DCF-ROI 18.5%. This was a result of the combination of a relatively large HTHP (36 GJ/h) with a high Coefficient of Performance (8.6).

In another partly government-funded project at PAPRICAN, ways of reducing the amount of energy used by paper and pulp machine dryer sections are being considered.

The drying sections of Canadian newsprint machines were studied and it was found that there was a great variation in energy consumption in these operations. Also, it was concluded that there is considerable potential for energy savings through

heat recovery and by reducing the amount of blow-through steam.

Following a study of the drying sections of market pulp machines, it has been determined that a similar amount of energy is used for pulp drying in air flotation and cylinder dryers while the flash dryers are more energy efficient. Also, a study of drying sections of machines producing four grades of paper and board revealed that, compared with newsprint, these grades require more drying energy, mostly because of less efficient pressing.

An energy audit of the dryer sections of one old and one new newsprint machine has been completed. It has been determined that the better energy economy of the new machine is due to a more efficient heat recovery system.

An easy method for carrying out energy audits of dryer sections has been developed and is being made available to mills.

In a Quebec government-funded project that is being conducted within the McGill University Chemi-

cal Engineering Department post-graduate program in conjunction with PAPRICAN, the process engineering fundamentals in flow and contacting processes are being studied to develop an understanding of transport phenomena and materials properties for processes involving fluid-solid interaction.

Energy aspects of this work include the development of new techniques for drying. In this context, research is being carried out on the SWIFT Drying Process, i.e., superheated steam with impingement and flow through.

It has been determined that for paper dried in superheated steam, the properties measured are equivalent to or better than the same paper dried conventionally.

The Future

The Canadian pulp and paper industry's energy conservation target for 1990 is a 33% reduction in purchased energy use per ton of product, compared with 1972. This target was achieved in 1987.

Pulp and Paper Industry Purchased Energy Consumption

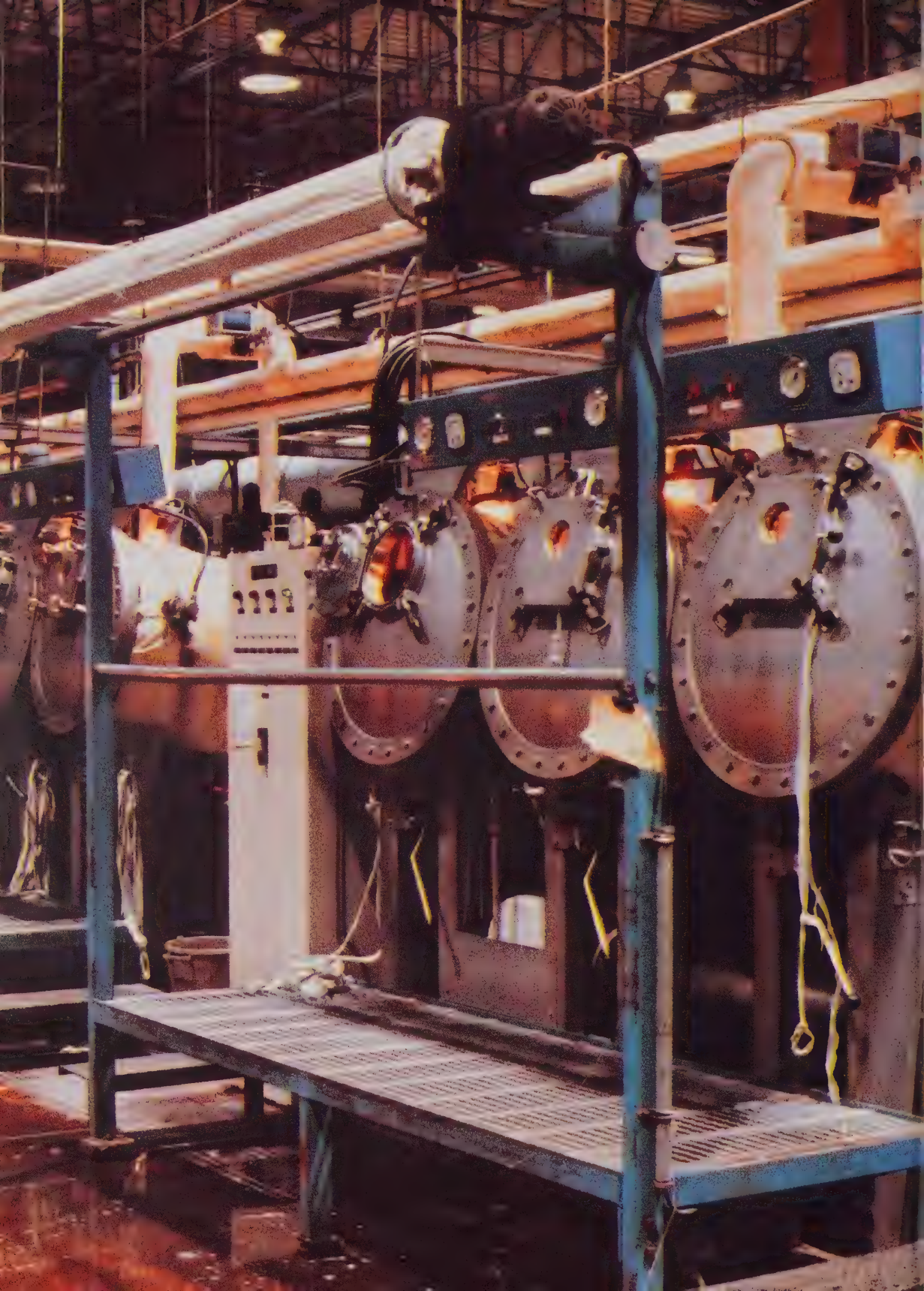
Type	1987** Petajoules	Percentage of Total	1986** Petajoules	Percentage of Total	1972* Petajoules	Percentage of Total
Natural Gas	85.26	26.7	80.74	25.9	95.70	20.1
Electricity (purchased)	152.79****	47.9	148.42***	47.5	115.09	24.1
Liquid Petroleum Products						
Distillate Oil	4.72	1.5	4.96	1.6	8.71	1.8
Residual Oil	69.01	21.6	69.97	22.4	235.26	49.3
Coal	4.77	1.5	5.97	1.9	16.55	3.5
Other Fuels						
L.P. Gas	0.78	0.3	0.73	0.2	0.95	0.2
Other	1.65	0.5	1.50	0.5	4.92	1.0
Totals	318.98	100.0%	312.29	100.0%	477.18	100.0%

*Reported on 1972 unit use adjusted to 1987 production

**Actual Use

***33.75 petajoules (10.8%) used in electric boilers

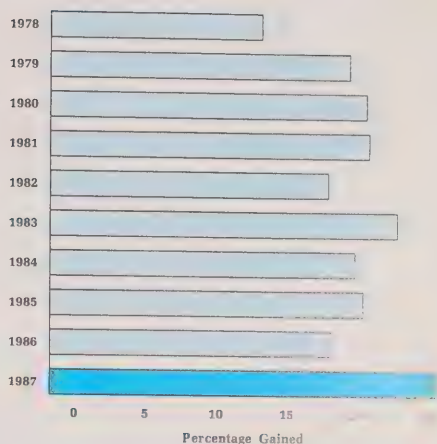
****32.91 petajoules (10.3%) used in electric boilers



Textile Industry

Energy Conservation Task Force

Luis G. Monton
Chairman



Energy efficiency improved in the primary textile industry by an impressive 6.8% in 1987.

The Textile Industry Energy Conservation Task Force, in conjunction with the Canadian Textiles Institute, shows the successful efforts of primary textile manufacturers to reduce energy consumption during the production and processing of both natural and man-made fibres and fabrics. These chemical and physical processes include knitting, spinning and weaving, dyeing and printing, bleaching, blending, brushing, tufting and twisting.

When Canadians think of textiles they usually think of the clothes they wear or the carpets they walk on. This is a misleading image of the primary textile industry which can and does produce material with five times the strength of steel. Textiles are used to produce body armour for policemen, reinforce airport runways and provide the structure for car tires.

In 1987, the primary textile industry produced over \$6.1 billion worth of product. The majority went to supply more than 150 manufacturing industries. Less than half the total output of the mills was sold to apparel manufacturers. Textiles form a vital part of the equipment used in the mining, forestry and fishing industries.

Some 63 leading establishments participating in the task force produce 90% of Canada's primary textiles. Apart from the companies which sell exclusively to other industries, the primary textile industry also includes those which produce finished products such as knitwear, drapes, carpets, blankets and towels for domestic consumption, as well as export.

Performance: A Good Year For Textiles

Energy efficiency in this industry improved by 6.8% during 1987.

When this figure is added to the improvement made between 1974 and 1985, the total energy improvement comes to 26.6%, already within 2.4% of the 1990 target set by the Textile Task Force.

This is remarkable when you consider the amount of imported greige goods which was a factor in the 1986 2.3% figure for 1986, is taken into account. Greige imports were up 179% in 1987. Greige goods are fabrics which must still be dyed and processed. These are "wet" processes which sometimes need three to four times more energy per kilo of product than other textile processes.

The increased efficiency rating for 1987 was based largely on capacity utilization in the textile mills, aided by the unexpectedly strong performance of the national economy which showed a growth of 3.4% GDP. In relation to the manufacturing sectors which showed

annual combined growth of 2.1%, primary textiles posted a 6.7% increase.

Driven by intensifying import competition, the primary textile industry is now concentrating on maximizing production. While new technologies are constantly being analyzed for energy efficient application in the industry, their implementation is limited by the need for short-term paybacks.

Consequently, most energy gains are still being made in housekeeping and in the techniques of maintenance. Projects being put forth are concentrating on areas where substantial gains can be achieved without incurring heavy capital costs.

The Textile Energy Conservation Task Force publishes two sets of documents: one stresses the need for increased energy efficiency, the other provides a networking effect for managers who are charged with increasing their plant's operational efficiency.

"Energy Conservation Notes" is a newsletter which has been used as a model by other CIPEC task forces and carries the message that energy efficiency results in a better bottom line. It also provides a roundup of energy efficiency news and the application of new techniques. "Energy Conservation Techniques", its sister publication, provides case studies demonstrating specific ways in which greater efficiency can be obtained.

While these two publications are addressed primarily to the men on the floor and to energy managers, the task force is now launching a pilot project on how best to bring home the energy efficiency message to busy CEOs.

This task force stresses energy "efficiency" over energy "conservation." Conservation as a concept has a negative connotation. Efficiency, on the other hand, relates directly

to the positive concern of senior management about building that better bottom line.

During 1987, the Textile Energy Conservation Task Force, through its Technical Liaison Subcommittee, organized two seminars, one in English, the other in French, on heating, ventilation and air conditioning. The excellent technical teaching manuals of Energy, Mines and Resources (EMR) formed the basis for the sessions which were augmented with textile case studies.

Both seminars were well attended by energy managers and the consensus of the attendees was that the hands-on approach was the best way to impart effective information. This can best be illustrated by the fact that during the case study portion of the seminars attendance was at its highest.

For 1988, in keeping with the objective of making the greatest energy gains with the least costs, the Technical Liaison Subcommittee is planning to hold two seminars, one in English and one in French, on the subject of steam. The seminars will deal with auditing, water treatment, steam traps, housekeeping, installations and retrofits.

Once again, EMR's technical manuals will be used as base material and the subjects will be given textile application by industry case histories. As well as industry professionals, technical colleges will be invited to send students to the seminars so that a new generation of industrial personnel will appreciate the values of energy management.

Case History

Bleaching, dyeing, printing and sanforizing are textile processes which consume great amounts of energy.

After exhaustive study and analysis by one large organization, it was suggested that energy savings could be made in four ways. Of

these, three of the methods provided extremely short payback periods — less than one month in two cases and one month in the third. The fourth project required a payback period of five years.

The first project involved the reduction in volume of combustion products and the fabric humidity exhausted outside the plant during the drying process. Exhaust was reduced from 14,000 cubic feet per minute (CFM) to 9,000 CFM without any consequent loss in quality. The costs were negligible as the modifications only involved changing a few pulleys. The savings are substantial and continuing — \$28,000 a year.

Project number two involved modifying the way that hot air was used during the drying process. Automatic controls were installed which allowed one fan to turn off after its initial use and the capacity of the remaining fan increased. This reduced the total volume of exhaust air being circulated from 9,000 CFM to 6,000 CFM per machine. The cost of the modifications was insignificant but the savings — \$14,000 per year.

The third project involved installing automatic burner controls to turn down the temperatures during production interruptions. These modifications were also done at low cost and for savings of \$10,000 per year.

The fourth project involved the installation of a Krantz air-to-air heat exchanger which recovers more than 50% of the energy contained in the drying process exhaust. The installation cost \$70,000 in 1983 and provides an annual saving of \$15,000. It should be noted that if the heat exchanger had been installed at the time of range construction, the cost would have been only \$40,000 and the payback period reduced from five years to three.

Except for the installation of the heat exchanger, all the modifica-

Textile Industry Energy Efficiency Improvement

Current year (1987) total energy inputs	9,285,403 gigajoules
New base year (1985) equivalent energy inputs	9,722,935 gigajoules

Net Improvement = 4.5%

Adjustments — None

Efficiency gain 1974 - 1985	22.1
1986	-2.3
1987	6.8
Total gain 1974 - 1987	26.6%

Textile Industry Energy Use

<u>Type</u>	<u>Units</u>	<u>Gigajoules</u>	<u>Percentage of Total Consumed</u>	
			<u>1987</u>	<u>1986</u>
Natural Gas	136,258,000 m ³	5,068,798	54.6	52.5
Electricity	943,559 MWh	3,396,812	36.6	36.7
Liquid Petroleum Products				
Distillate Oil	287 kilolitres	11,193	0.1	0.1
Residual Oil	17,184 kilolitres	726,883	7.8	9.8
Diesel and Gasoline	421 kilolitres	16,019	0.2	0.2
Other Fuels				
Propane and LPG	1,600 m ³	42,560	0.5	0.5
Other Gaseous Fuels	460 m ³	23,138	0.3	0.2
Total		9,285,403		

tions to cut energy consumption at this plant involved minor adjustments and modifications. The message is clear: energy efficiency can be found in both large and small applications.

Energy Use Patterns

Natural gas at 54.6% (up 2.1%) still provides most of the energy used. Electricity provides 36.6%, heavy oil

7.8%, with other energy sources providing less than 1%.

Outlook and Concerns

While the primary textile industry has now come close to its 1990 goal for efficiency gains, the ongoing concern is maximizing production. Temporarily, low fuel prices have reduced some interest in energy efficiency. The task force realizes that

in this situation the best way to promote energy efficiency is to concentrate on the ways in which energy gains can be made at negligible costs.

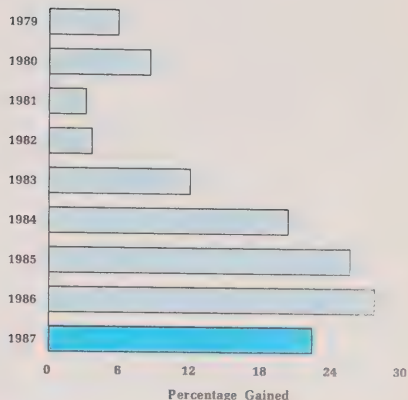
For these reasons it is continuing its seminar and publication programs, and at the same time studying how to revive energy efficiency consciousness, particularly among chief executive officers.



Transportation Industry (Manufacturing)

Energy Conservation Task Force

George Heidebrecht
Chairman



Task Force Profile

The Transportation Industry (Manufacturing) Task Force was established in 1975 to promote energy management and conservation among the membership of six participating trade associations.

- Aerospace Industries Association of Canada (AIAC)
- Allied Boating Association of Canada (ABAC)
- Automotive Parts Manufacturers Association (APMA)
- Canadian Shipbuilding and Ship Repairing Association (CSSRA)
- Canadian Truck and Trailer Manufacturers Association (CTTMA)
- Motor Vehicles Manufacturers' Association (MVMA)

These six trade associations represent 439 companies of various size. Although only 58 companies reported for 1987, they do, however, use 80% of the total energy consumed by the transportation sector.

Those reporting are, in general, larger companies which practise organized energy management and conservation.

Task Force Activities

The task force, in order to revitalize interest in the importance of proper energy management and conservation, embarked on a promotional campaign.

A professionally designed "Energy" brochure was mailed to the Chief Executive Officers of all 439 companies. It stresses the importance of proper energy management and encourages task force participation. The response is presently being evaluated and future mailings are planned. The next, to the company energy contacts, is scheduled for early Fall 1988.

In addition, the data collection forms will be simplified and, under

consideration, is the use of the services of a retired task force committee member to assist companies with their energy auditing and data collection.

The "Idea Exchange" letter has retained its popularity and is distributed to approximately 1,000 companies.

During 1987, task force meetings continued on a regular basis. The topics for discussion ranged from energy management ideas to government policies and the continuously fluctuating fuel prices.

Promotion of energy management and participation in this worthwhile program will remain the primary goals of the task force.

Energy Use Patterns

The energy use table illustrates the distribution of the various types of fuel.

A definite shift from residual oil (No. 6 Oil) to natural gas, and a slight but steady increase in the use of electricity are indicated.

Since 1980 the share of residual oil has dropped from 14.7% to 1.7%, while the share of natural gas has risen from 49.1 to 56.7%.

At the same time, the share of electricity has increased from 23.6 to 32.8%. As plants become more and more automated, electricity, because of its ease of control, will gain in popularity.

As we are presently experiencing a drastic reduction in the price of natural gas, a steady increase in the cost of electricity and fluctuating oil prices, it remains to be seen what the future trend will be.

Performance

During 1987, compared with the adjusted base year of 1985, the task force incurred a deficiency of 3.3% instead of the anticipated 2% improvement in efficiency.

We believe this deficiency is the result of reduced priority and emphasis on energy management due to lower gas and oil prices, reduction in production volumes and the

use of hi-tech, but highly energy-intensive equipment.

The reduction in production volumes and the installation of hi-tech equipment are the result of offshore competition. Plant changeovers resulting in zero production for as long as one year have also had a negative effect on energy efficiency. Further reasons for negative reports is the fact the production volumes and quality, in order to meet customer demand, are given priority. Also, with the present emphasis on industrial hygiene (e.g., plant air quality), very energy-intensive HVAC equipment is being installed.

Subsector Performance

The sector performance table indicates an excellent one year improvement of 5.2% by the Aerospace Industries' Association.

The Canadian Shipbuilding and Ship Repairing Association also reports an excellent one year improvement in efficiency of 15.2%.

The Automotive Parts Manufacturers' Association reported a 3.9% improvement.

The deficiency in improvement of 6.6% reported by the Motor Vehicle Manufacturers' Association, the task force's major energy consumer, indi-

cates the direct result of offshore competition.

The task force committee is confident that the planned activities of direct contact with companies of the Allied Boating Association and the Canadian Truck and Trailer Manufacturers' Association will improve participation.

Future Outlook and Concerns

All indications are that, in 1988, we will not enjoy a healthy economy similar to that of 1986 and part of 1987. Thus, being faced with the ever increasing onslaught of offshore competition, we must, in order to regain a healthy economy, continue to improve our productivity and energy management.

The results of the 1987 data collection and the declining participation by the various task force subsector indicate a reduced emphasis on energy management. This could be the result of low gas and oil prices overloaded company staff, or higher priority business issues.

In view of the above, the Transportation Industry Task Force remains confident that, using 1985 as the base year, the goal of a 35% improvement in energy efficiency by 1990 is still within reach.

Transportation Industry Energy Efficiency Improvement

Current year (1987) total energy inputs	40,148,007 gigajoules
New base year (1985) equivalent energy inputs (adjusted)	38,865,967 gigajoules
Net Improvement	= -3.3%
Efficiency gain 1978 - 1985	25.6
1986	2.1
1987	-5.4
Total gain 1978 - 1987	22.3%

Adjusted base year inputs are the reflection of changes in weather, volumes of production, changes in manpower and changes in manufacturing areas.

Transportation Industry Energy Use

Type	Units	Gigajoules	Percentage of Total Consumed						
			1987	1986	1985	1984	1983	1982	1980
Natural Gas	611,930,904 m ³	22,763,830	56.7	55.7	54.7	54.1	52.1	53.0	49.1
Electricity	3,657,904 MWh	13,168,454	32.8	30.7	30.1	29.3	28.4	26.9	23.6
Liquid Petroleum Products									
Distillate Oil	6,261,981 litres	243,542	0.6	1.3	1.2	1.2	1.4	1.8	0.7
Crude Oil	n/a	—	—	0.2	—	—	—	—	—
Residual Oil	15,696,384 litres	663,957	1.7	1.8	2.1	3.6	6.3	7.5	14.7
Gasoline	667,750 litres	29,733	0.1	0.1	0.1	0.1	0.1	0.5	0.2
Diesel	877,687 litres	35,020	0.1	0.1	0.2	0.3	0.2	0.4	0.3
Coal	28,152 tonnes	903,679	2.2	3.5	3.5	3.8	4.0	3.9	5.9
Coke	95,033 tonnes	2,214,269	5.5	6.1	7.4	7.3	7.2	5.6	5.1
Other Fuels									
Propane	3,548,196 litres	94,382	0.2	0.5	0.6	0.3	0.3	0.4	0.4
LPG	125,650 litres	31,141	0.1	—	—	—	—	—	—
Total		40,148,007							

Transportation Industry Energy Efficiency

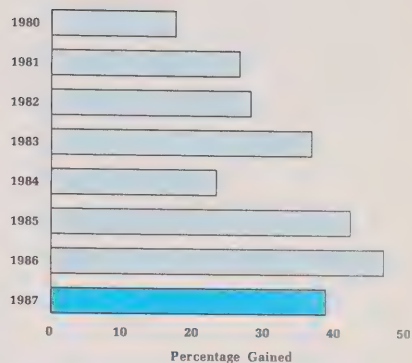
Subsector	Base Year 1985				Base Year 1978				
	1987	1986	1985	1984	1983	1982	1981	1980	1978
ABAC (Boating)	—	—	—	12.9	3.1	-48.5	-88.1	—	-0.7
AIAC (Aerospace)	5.2	5.2	20.6	7.9	7.3	3.9	-43.7	6.0	-1.2
APMA (Autoparts)	3.9	2.7	6.5	13.5	11.7	5.8	26.7	15.6	3.3
CSSRA (Shipbuilding)	15.2	-19.4	11.4	-2.9	-10.6	-21.1	48.8	-14.1	-9.0
CTTMA (Truck/Trailer)	9.0	—	-26.3	-15.4	-56.9	-65.2	25.6	-18.1	-0.2
MVMA (Motor Vehicles)	-6.6	2.0	28.8	22.8	-6.3	3.3	—	—	—
Task Force	-3.3%	2.1%	25.6%	20.3%	1.2%	3.7%	3.2%	4.5%	0.4%



Wood Products Industry (Western)

Energy Conservation Task Force

R.C. Bryan
Chairman



Task Force Description

The Wood Products Industry (Western) Task Force was formed by the Council of Forest Industries of British Columbia (COFI) in 1978 and represents 80 companies with more than 100 sawmills and 15 plywood and veneer mills. COFI members and affiliates account for more than 90% of the total product value of the forest industries in B.C.

Most mills in western Canada are members of industry trade associations which actively pursue a wide variety of business issues of common interest. In British Columbia, the major forest industry associations are the Council of Forest Industries of B.C., its Northern Interior Lumber Sector (NILS), the Cariboo Lumber Manufacturers' Association (CLMA) and the Interior Lumber Manufacturers' Association (ILMA). CLMA and ILMA are also affiliate members of COFI.

This survey covers 44 operating sawmills owned by 22 companies, which accounted for 36% of all the lumber produced in B.C. in 1987. The reporting sample covers mills of all sizes and represents all regions of the province.

Goals and Progress to Date

The industry's goal for 1990 is a 7% overall increase in energy efficiency from the 1985 base year performance. However, the industry's overall energy efficiency in 1987 declined from the level achieved last year and, based on the current sample of reporting companies, the 1987 results were still a 38.9% improvement over the 1978 performance.

Average electrical energy consumption for the production of green lumber lost ground in 1987 and was almost 2% more than in 1985. Compared with 1978, however, the 1987 performance represented a 17.5% improvement.

The average natural gas consumption in the kiln drying of lumber in 1987 was up by over 8% compared with the 1985 level. When compared with the 1978 consumption, the 1987 performance represented a 50.5% improvement.

Although the sample of reporting mills in 1987 accounted for the same percentage of lumber produced as in 1985, unfortunately there were significant differences in terms of the actual mills which responded to the survey. The results are sensitive to changes in reporting patterns among mills, particularly those in the past which used natural gas-fired kilns to dry their lumber but then converted to using sawmill residues. Such a conversion does not require purchased fuel in the drying of lumber. In subsequent years this is reflected in a significant improvement in energy efficiency. The lumber sector, provided that the mills continue to respond to the survey, fortunately, not all of them.

those which do continue to report do not do so every year. This largely explains the apparent increase in natural gas use, since mills do not normally convert back to natural gas after using sawmill residues.

The marginally higher use of electricity in 1987 compared with 1985 may, to some extent, reflect the difference in samples but may also be explained by record production levels attained in 1987. Mills operating at very high output levels are likely to be focusing on maintaining throughput rather than conserving energy.

At the beginning of 1987 the industry saw a 15% export charge imposed on lumber destined for the U.S. market. The export tax was enshrined in a more permanent way through an increase in stumpage charges and other forest management costs totalling approximately \$600 million per year commencing in October 1987. While these increased charges can be borne by the industry during this period of relatively good markets, concerns are being voiced about the impact of such charges when markets again become depressed.

Neither B.C. Hydro electricity rates nor natural gas prices rose in 1987 for the industry. In fact, natural gas prices declined dramatically for large industrial users, such as pulp mills and somewhat less dramatically for the sawmill sector. This lessened the incentive for sawmills to convert to burning residues.

Task Force Activities

Higher levels of production have meant a modest increase in employment in most companies. Productivity-enhancing investments and improved operations techniques have, however, held increases in staffing to a minimum. It should become easier to reactivate the task force as staffing levels increase.

In 1987, COFI staff continued to disseminate information regarding conservation activities to member mills and to monitor the energy performance of the sector.

Future Outlook

Despite significant improvements in off-shore lumber markets and in other sectors of the forest industry North American lumber markets appear to be softening marginally. Housing starts are generally expected to decline in 1988, but lumber consumption may not be seriously affected providing the decline is not too heavily focused in single-family starts. Other uses for lumber continue to grow in North America. Also, off-shore sales are expected to remain firm for the short term but are dependent on continuing modest levels of economic growth and favourable exchange rates.

The uncertainties in lumber markets provide few incentives for major energy efficiency-type investments. Similarly, the lowering of natural gas rates is likely to continue for a number of years as groups of sawmills negotiate direct purchase agreements with natural gas producers and add to those savings through transportation service agreement with pipelines. These events make it difficult for sawmills to justify major natural gas-saving investments at this time.



Wood Products Industry (Western)

Energy Efficiency Improvement

Green Lumber

	<u>1987</u>	<u>1985</u>	<u>1978</u>
Total sample production (million board feet — MMFBM)	5661.0	5052.0	4202.2
Total energy consumption (10^{12} J)	2554.3	2241.5	2297.7
Average electrical energy consumption (10^9 J per MFBM)	0.451	0.444	0.547
Current year total electrical energy inputs (10^{12} J)	2554.3	2241.5	2297.7
Comparison base year (1985) equivalent energy inputs (10^{12} J)	2511.7		
Comparison base year (1978) equivalent energy inputs (10^{12} J)	3095.3		

Improvement (1985 base year) = -1.7%

Improvement (1978 base year) = 17.5%

Kiln Dried Lumber

	<u>1987</u>	<u>1985</u>	<u>1978</u>
Total sample production (MMFBM)	3395.4	3159.4	1013.0
Total energy consumption (mainly natural gas) 10^{12} J	2833.5	2433.0	1708.8
Average energy consumption (10^9 J per MFBM)	0.835	0.770	1.687
Current year total energy inputs (10^{12} J)	2833.5	2433.0	1708.8
Comparison base year (1985) equivalent energy inputs (10^{12} J)	2614.7		
Comparison base year (1978) equivalent energy inputs (10^{12} J)	5724.9		

Improvement (1985 base year) = -8.4%

Improvement (1978 base year) = 50.5%

Combined Energy Performance

	<u>1987</u> <u>Actual</u>	<u>1985</u> <u>Equiv.</u>	<u>1978</u> <u>Equiv.</u>
Total electrical energy consumption (Green Lumber 10^{12} J)	2554.3	2511.7	3095.3
Total natural gas consumption (Kiln Dried 10^{12} J)	2833.5	2614.7	5724.9
Total sector energy consumption 10^{12} J	5387.8	5126.4	8820.2

Improvement (1985 base year) = -5.1%

Improvement (1978 base year) = 38.9%



Reporting Companies

Chemical

Alberta Gas Chemicals Ltd.
 Alby Chlorates Canada Inc.
 Ashland Chemicals
 Atkemix Inc.
 BASF Canada Inc.
 Blachford, H.L., Ltd./Ltée
 Borden Chemical
 British Columbia Chemicals Ltd.
 Carlew Inc.
 Celanese Canada Inc.
 Commercial Alcohols Limited
 Cyanamid Canada Inc.
 Dominion Colour Company
 Domtar Chemicals Group
 Dow Chemical Canada Inc.
 Du Pont Canada Inc.
 Esso Chemical Canada
 Ethyl Canada Inc.
 General Chemical Canada Ltd.
 Goodrich, B.F., Canada Inc.
 Hart Chemical Limited
 Inkel Canada Ltd.
 Imont Canada Inc.
 Iochst Canada Inc.
 Iuls Canada Inc.
 Iubrizol Canada Limited
 Ionsanto Canada Inc.
 Iacan Products Limited
 Iational Silicates Limited
 Iitrochem Inc.
 IL Chem Canada Inc.
 Iovacor Chemicals Ltd.
 Icelot Ammonia Company
 Ietromont Inc.
 Igment & Chemical Inc.
 Ilysar Limited
 Iquantum Chemical Ltd.,
 I Emery Division
 IQuéNord Inc.
 Ired Inc.
 Ihm & Haas Canada Inc.
 IShell Canada Chemical Company
 I Silco Chemicals Limited
 Iurpass Chemicals Limited
 Ioxide Canada Inc.
 I Union Carbide Canada Limited
 Iuroyal Chemical

Electrical and Electronic

Acan Wire and Cable
 Andrew Antenna Co. Ltd.

Arcan Canada
 Ascoelectric Ltd.
 ASEA Inc.
 Brown Boveri Canada Inc.
 Black & Decker Canada Inc.
 B.B. Howden Inc.
 Burndy Inc.
 Camco Inc.
 Canada Wire and Cable Limited
 Commander Electrical Materials Inc.
 Commander Electrical
 Equipment Inc.
 Crouse-Hinds Electrical
 Construction Materials
 Eaton Yale Ltd.
 Edwards, a Unit of General
 Signal Ltd.
 Federal Pioneer Limited
 Garrett Canada
 General Electric Canada Inc.
 General Wire & Cable
 Gennum Corporation
 Gould Electronics Canada
 Gould Shawmut Company
 GTE Sylvania Canada Ltd.
 Honeywell Limited
 Hoover Canada Inc.
 Inglis Limited
 Iona Appliances Inc.
 ITT Cannon Canada
 Lincoln Electric Co. of Canada Ltd.
 Manville Canada Inc.
 Marine Industrie Limitée
 Moloney Electric Corporation
 Motorola Information Systems
 NEI Ferranti-Packard
 Electronics Ltd.
 Phillips Cables Limited
 RCA Inc.
 Sangamo Canada
 Siemens Electric Limited
 Spar Aerospace Limited
 Texas Instruments Canada Limited
 Trench Electric
 Westinghouse Canada Limited
 WCI Canada Inc.
 3M Canada Inc.

Ferrous Metals

Algoma Steel Corporation
 Dofasco Inc.
 Sidbec-Dosco Inc.
 Stelco Inc.
 Sydney Steel Corporation (Sysco)

Food and Beverage

Association of Canadian Biscuit Manufacturers

Christie Brown Ltd.
 Colonial Cookies Ltd.
 Culinar Inc.
 Dare Foods Limited
 InterBake Foods Limited
 Manning Biscuits Ltd.

Association of Canadian Distillers

Alberta Distillers Limited
 Andrés Wines Ltd.
 Canadian Mist Distillers Limited
 Corby Distilleries Ltd.
 FBM Distillery Co. Limited
 Gilbey Canada Inc.
 Gooderham & Worts
 Hiram Walker & Sons Limited
 McGuinness Distillers Limited
 Palliser Distillers Limited
 Schenley Canada Inc.
 Seagram, Joseph E., & Sons, Limited

Bakery Council of Canada

Ben's Limited
 Corporate Foods Limited
 Eastern Bakeries Limited
 McGavin Foods Limited
 Multi-Marques Inc.
 Weston Bakeries Limited

Brewers Association of Canada

Carling O'Keefe Breweries
 Labatt Brewing Company Limited
 Molson Breweries of Canada
 Limited
 Moosehead Breweries Limited
 Northern Breweries Ltd.
 Pacific Western Brewing Co.
 The Ottawa Valley Brewing Co.
 Upper Canada Brewing Co.

**Canadian Food
Processors Association**

Campbell Soup Company Ltd.
Canadian Cannery Limited
Heinz, H.J., Company of
Canada, Ltd.
Hunt-Wesson Canada Ltd.
Kraft Limited
Libby, McNeill & Libby Inc.
Lord, David Limitée
Morrison Lamothe Frozen
Foods Ltd.
Produce Processors Limited
Royal City Foods Ltd.
Smith, E.D., & Sons Limited
Snowcrest Packers Ltd.
Sun-Brite Canning Ltd.
Thomas Canning (Maidstone) Ltd.

Canadian Meat Council

Burns Meats Limited
Canada Packers Inc.
Export Packers Inc.
Fearman, F.W., Company Ltd.
Intercontinental Packers Ltd.
Piller Sausages & Delicatessens Ltd.
Quality Meat Packers Ltd.
Schneider, J.M. Inc.
Supreme Packers Inc.
Vancouver Fancy Meats Co. Ltd.

**Canadian Poultry and
Egg Processors Council**

A.C.A. Co-operative
Association Ltd.
Bexel-Division de la Co-op.
Fédérée de Québec
Canada Packers Inc.
Co-op Dorchester Ltée
Lashbrook Produce Limited
Lilydale Co-op Limited
Lilydale Poultry Sales (Victoria) Ltd.
Lucerne Foods Ltd.
Maple Leaf Mills Limited
Maple Lynn Foods Ltd.
Tend-R-Fresh Poultry Products Ltd.
P & H Foods Ltd.
Volco Limited

**Canadian Soft Drink
Association**

Beverage Services Ltd.
Blackwoods Beverages Ltd.
(Calgary)
Blackwoods Beverages Ltd.
(Winnipeg)
Canada Dry Ltd.

Cassidy's Beverages Limited
Coulombe Québec Limitée
Désormeaux, S., Inc.
Gray Beverage Company Ltd.
Gray Beverages (Alberta) Ltd.
Gray Beverages (Island) Co.
H.P.I. Beverages Ltd.
Ideal Sport Inc.
Kitchener Beverages Ltd.
Larrivée et Frères Inc.
Liqueurs Saguenay Ltd.
Maedel's Beverages Ltd.
Maritime Beverages Ltd.
Misener Beverages Ltd.
Pathfinder Beverages Ltd.
Pepsi/Seven-Up Bottling
of Toronto Ltd.
Saskal Beverages Ltd.
Seven-Up (Saskatoon) Ltd.
Seven-Up (Valleyfield) Ltée
Simard, Philippe, & Fils Ltée
Starlite Bottlers Ltd.
Swift Current Bottlers Ltd.
T.C.C. Bottling (Calgary) Ltd.
T.C.C. Bottling (Edmonton) Ltd.
T.C.C. Bottling (St-Paul) Ltd.

Canadian Sugar Institute

British Columbia Sugar Refining
Company Limited
Lantic Sugar Limited
Redpath Sugars Limited
St. Lawrence Sugar Division
Natalik Inc.
Westcane Sugar Limited

**Confectionery Manufacturers
of Canada**

Adams Brands Inc.
Dare Foods Limited
Hershey Canada (Montréal) Inc.
Hershey Canada (Smith Falls) Inc.
Laura Secord Inc.
Leaf Confections Ltd.
Neilson, William, Ltd./Ltée
Rowntree, Mackintosh Canada Ltd.
Wrigley Canada Inc.

Fisheries Council of Canada

British Columbia Packers Limited
Connor Bros. Limited
National Sea Products Limited
Omstead Foods Limited

**Grocery Products Manufacturers
of Canada**

Binet & Turgeon Ltée
Catelli Inc.
Culinar Inc.

General Foods Inc.
Gerber (Canada) Inc.
Jacobs Suchard Canada Inc.
Lancia Bravo Foods Limited
Lipton, Thomas J., Inc.
Monarch Fine Foods
Nabisco Brands Ltd.
Nabisco (Canned Goods) Ltd.
Nabisco Food Services

Starch Council of Canada

Casco Limited
Nacan Products Ltd.
Ogilvie Mills Ltd.
St. Lawrence Starch Co. Ltd.

General Manufacturing

Rubber Products

Gates Canada Inc.
General Tire Canada Limited
Michelin Tires (Canada) Ltd.
Trent Rubber Services Limited
Uniroyal Goodrich Canada Ltd.

**Chemical, Pharmaceutical
and Medical Products**

Canadian Occidental Petroleum
Limited
Glaxo Canada Inc.
Johnson & Johnson Inc.
Merck Frosst Canada Inc.
Tambrands Canada Inc.
Pratt & Lambert Inc.
Valspar Chemicals Ltd.

**Foundries, Forgings and
Heavy Metal Processors**

Aciers Slater
Brass Craft Canada Limited
Brown Foundry Ltd.
Canada Forgings Inc.
Canada Metal Company Limited
Canadian Bronze Company Limited
Canron Inc.
Canvil Ltd.
Darling Duro Limited
Esco Ltd.
Fonderie Magotteaux Canada Ltée
Gray Forgings & Stampings Limited
Huron Steel Products (Windsor) Ltd.
Lake Ontario Steel Company
Limited
Manville Canada Inc.
Metals & Alloys Company Limited

Light Manufacturing

American Standard Inc.
Annapolis Valley Peat Moss Co. Ltd.
Atlantic Industries (N.B.) Ltd.
Atco Limited
Black and Decker Canada Inc.
Bombardier Inc.
Canadian General Tower Ltd.
Commercial Aluminum, Division
of Indal Ltd.
Cooper Tools
Dorr-Oliver Canada Limited
GSW Water Products Company
Indal Technologies Inc.
Indalloy Ltd., Division of Indal
Inverex Corporation
Jarvis Clarke Company Limited
Lawneer Company Canada Limited
Modak Canada Inc.
Reitz, Ernst, Canada Limited
Maclean Hunter Company Limited
VCR Canada Ltd.
Oneida Canada Limited
Paddle Valley Products Limited
JR-MacDonald Inc.
Snap-On Tools of Canada Ltd.
KID Manufacturing
Teledyne Canada Metal Products
Temprite Industries Ltd.
Trane Canada
V.C. Wood Limited

Industrial Minerals

Abrasives

Electro Minerals Inc.
Exolon-Esk Company of Canada Ltd.
General Abrasives Canada Limited
Porton Canada Inc.

Asbestos

Brinco Mining Ltd., Cassiar Division
Grey Canada Inc.
J4 Asbestos Inc.
Lib Chrysotile Inc.

Cement

Canada Cement Lafarge Ltd.
Cement Québec Incorporated
Federal White Cement Limited
Gonstar Cement Limited
Lake Ontario Cement Limited
North Star Cement Limited
S. Lawrence Cement Inc.
S. Marys Cement Company

Clay Brick and Tile

Briqueterie St-Laurent Ltée
Canada Vitrified Products Limited
Estevan Brick Limited
Hamilton Brick Ltd.
I-XL Industries Ltd.
Medicine Hat Brick and Tile Ltd.
Medicine Hat Sewer Pipe Ltd.
National Sewer Pipe Limited
Northwest Brick and Tile Ltd.
Redcliff Pressed Brick Ltd.
Red River Brick and Tile

Concrete Products

Consolidated Concrete Ltd.
Con-Force Structures Limited
Doughty Concrete Products Ltd.
Downey Building Materials Ltd.
Richvale Block and Ready-Mix
Redi-Mix Limited
York Block and Supply Limited

Glass

AFG Glass Inc.
Consumers Packaging Inc.
Domglas Inc.
Fiberglas Canada Inc.
PPG Canada Inc., Glass Division

Lime

Havelock Lime Company of
Canada Limited
Reiss Lime Company of
Canada Limited
Summit Lime Works Limited

Miscellaneous Minerals

Indusmin Limited
Saskatchewan Minerals
Steetley Talc Inc.
3M Canada Inc.

Refractories

Green, A.P., Refractories (Canada)
Canadian Refractories Limited
Clayburn Refractories Limited
Continental Refractories
Company Limited

Machinery

ACCO Canadian Material Handling,
a Division of Dominion Chain Inc.
Beloit Canada Ltée/Ltd.
Bingham International Inc.
Boart Canada Inc.
Canadian Blower/Canada Pumps
Limited
Canon Inc., Mechanical Division
Continental Conveyor & Machine
Works Ltd.
Continuous Mining Systems Limited
Crane Canada Inc., Valve &
Industrial Division
R.J. Cyr Co. Inc.
Dominion Engineering Works,
a Division of Canadian General
Electric Company Limited
Ebco Industries Ltd.
Edson Packaging Machinery Limited
FAG Bearings Ltd.
Farris Industries Canada
FMC of Canada Limited, Material
Handling Operation
Greys Lightning, Unit of General
Signal Limited
Heath & Sherwood (1964) Limited
Industries USP Inc.
Ingersoll-Rand Canada Inc.
H.G. Kalish Inc.
Kockums CanCar Inc.
Motivation Industrial
Equipment Ltd.
MTD Products Ltd.
Pathex International Ltd.
Provincial Crane Inc.
RMS Machinery Division, Uniroyal
Goodrich Canada Inc.
Smart Turner Limited
Union Pump (Canada) Ltd.
Ward Ironworks Limited
WEMCO Canada, Division of Baker
International Canada Ltd.

Mining and Metallurgy

Cominco Ltd.
Denison Mines Ltd.
Eldorado Resources Limited
Falconbridge Limited
Giant Yellowknife Mines Limited
Hudson Bay Mining and Smelting
Co., Limited
Inco Limited
Iron Ore Company of Canada Ltd.
Noranda Minerals Inc.
Placer Dome Inc.
Quebec Cartier Mining Comp
Rio Algom Limited
Syncrude Canada Limited

Petroleum Refining

Consumers' Co-Operative
Refineries Limited
Esso Petroleum Canada
Husky Oil Products Company
Petro-Canada Products Inc.
Shell Canada Limited
Suncor Inc.
Syncrude
Texaco Canada Inc.
Turbo Resources Limited
Ultramar Canada Inc.

Plastics

Aclo Compounders Inc.
American Biltrite Canada Ltd.
Amhil Enterprises Ltd.
Atlantic Packaging Products Ltd.
Beaver Plastics Limited
Bonar Rosedale Plastics Ltd.
Canada Cup Inc.
Canadian General-Tower Ltd.
Carlew Chemicals Ltd.
Cascades Dominion Inc.
Celfortec Inc.
Chantler & Chantler Inc.
Chemacryl Plastics Limited
C-I-L Inc.
Coastal Plastics Ltd.
Daymond, a Division of Redpath Inc.
Domtar Construction Materials
Duron Plastics Ltd.
Ferro Industrial Products Limited
Fibracan Inc.
Formica Canada Inc.
F&H Plastics Ltd.
Hayden Manufacturing Co. Ltd.
IPL Inc.
I.T.W. Plastiglide
Jet Moulding Compounds Limited
Manuplast Inc.
Mattel Canada Inc.
Morbern Inc.
Norseman Plastics Limited
Pavaco Plastics Inc.
Persita Inc.
Plasti-Drain Ltée
Plax Inc.
Propak Plastics Ltd.
Polytainers Limited
Pro-Western Plastics Ltd.
Rubbermaid Canada Inc.
Sculpturethane Corp.
Spartan Plastics Canada Inc.
Uniplast Industries Inc.
Westra Inc.

Pulp and Paper

Abitibi-Price Inc.
Atlantic Packaging Products Ltd.
Armstrong World Industries
Canada Ltd.
Beaver Wood Fibre Company
Limited
Boise Cascade Canada Ltd.
Bowater Mersey Paper Company
Limited
British Columbia Forest Products
Limited
Canadian Forest Products Ltd.
Cariboo Pulp and Paper Company
Cascades (East Angus) Inc.
Cascades (Jonquière) Inc.
Celgar Pulp Company
Champion Forest Products
(Alberta) Ltd.
CIP Inc.
Consolidated-Bathurst Inc.
Crestbrook Forest Industries Ltd.
Crown Forest Industries Limited
Domtar Inc., Pulp and Paper
Products
Donohue Inc.
Donohue Normick Inc.
Donohue St. Félicien Inc.
E.B. Eddy Forest Products Ltd.
Eurocan Pulp and Paper Co. Ltd.
La Cie J. Ford Ltée
Fraser Inc.
Gaspesia Pulp and Paper
Company Ltd.
Great Lakes Forest Products Limited
Industries James Maclaren Inc.
Irving Pulp and Paper, Limited
Island Paper Mills Limited
James River-Marathon, Ltd.
Kimberly-Clark of Canada Limited
Kruger Inc.
MacMillan Bloedel Limited
Malette Kraft Pulp & Power
Manfor Ltd.
Minas Basin Pulp & Power Company
Limited
Miramichi Pulp & Paper Inc.
NBIP Forest Products Inc.
Northwood Pulp & Timber Limited
Paperboard Industries Corporation
Papier Cascades (Cabano) Inc.
Perkins Paper Ltd.
Procter & Gamble Inc.
Quebec and Ontario Paper Company
Limited
Reed Inc.
Rolland Inc.
Rothsay Paper Limited
St. Anne-Nackawic Pulp & Paper
Company Ltd.
St. Marys Paper Inc.
Scott Maritimes Limited
Scott Paper Limited
Skeena Cellulose Inc.

Sonoco Limited
F.F. Soucy, Inc.
Spruce Falls Power & Paper
Company, Limited
Stora Forest Industries
Strathcona Paper Company
Tembec Inc.
Western Pulp Limited Partnership
Weyerhaeuser Canada Inc.

Canadian Textiles Institute

Albany International Canada Inc.
Artex Woollens Limited
Asten-Hill Inc.
Badische Canada Ltd.
Barrymore Carpet Inc.
Bell Tootal Inc.
Bermatex Inc.
H.N. Biron & Fils Inc.
Britex Ltd.
Burlington Canada Inc.
Tricots Canada U.S. Inc.
Celanese Canada Inc.
Cleyn & Tinker Inc.
C&T Modele Inc.
Coats, J. & P., (Canada) Inc.
Consoltex Inc.
Fashion Division –
• Cowansville
• Drummondville
Home Furnishings Division –
• Sherbrooke
Outerwear Division –
• Alexandria
• Montmagny
• Coaticook
Crossley Karastan Carpet Mills Ltd.
DeBall, J.L., Canada Limited
Dominion Textile Inc.
Apparel Fabrics –
• Beauharnois Finishing Plant
• Domil, Sherbrooke
• Drummondville
• Long Sault, Fabrics
• Magog
Consumer Products –
• Caldwell, Iroquois
• Sherbrooke
• Esmond, Granby
• Magog
Sales Yarn –
• Domil, Sherbrooke
• Long Sault, Yarns
• Mount Royal Dye House,
Montreal
Industrial Products –
• Drummondville
• Yarmouth
• Hawkesbury
• Woodstock

Drytex, Division of JWI Ltd.
 Dura Undercushions Ltd.
 Les Tricots Duval &
 Raymond Ltée
 Harding Carpets Limited
 Harvey Woods Limited
 Heuga Canada Limited
 Huyck Canada Limited
 Leedye Inc.
 Newlands Textiles Inc.
 Nova Scotia Textiles Ltd.
 Ozite Canada (1981) Inc.
 Patons & Baldwins
 Canada Inc.
 Peeters Carpets Ltd.
 Payonese Textile Inc.
 Polyco Inc.
 Rumpel Felt Company
 Limited
 Ratexil Inc. Division Texgran
 Rapis Coronet Inc.
 Rapis Peerless Ltée
 Rapis Venture Canada Ltée
 Textiles Dionne Inc.
 • St. Georges de Beauce Division
 • Montmagny Division
 • Drummondville Division
 Waterville Cellular Products Ltd.

Transport

Aerospace Industries Association of Canada

Aircraft Appliances and
 Equipment Limited
 Bendix Avelex Inc.
 B & M Helicopters
 CAE Industries Ltd.
 Canadair Limited
 Canadian Marconi Company
 Chicopee Manufacturing Limited
 Computing Devices Company
 Field Aviation East Ltd.
 Garrett Canada
 Haley Industries Ltd.
 Haldal Technologies Inc.
 Hutton Systems Canada Limited
 Lucas Industries Canada Limited
 McDonnell Douglas Canada Limited
 MEL Defence Systems
 Pratt & Whitney Canada Inc.
 Raytheon Canada Limited
 Rockwell International of
 Canada Ltd.
 Rolls-Royce (Canada) Limited
 Spar Aerospace Limited
 Suisys Canada Inc.

Automotive Parts Manufacturers' Association

Agood's, Division of Aluminum
 Company of Canada Ltd.

B & W Heat Treating (1975) Limited
 Beckers Lay-Tech Inc.
 Bendix Engineering (Can.Fram)
 Blackstone Industrial Products
 Limited
 Budd Canada Inc.
 CAE Accurcast
 Canada Forging Inc.
 Champion Spark Plugs Co.
 of Canada Inc.
 Daymond, a Division of Redpath
 Industries Limited
 FAG Bearings Ltd.
 Fahramet Steel Castings
 Galtaco Inc.
 Goodyear Canada Inc.
 Hayes-Dana Inc.
 Hoover Universal of Canada
 Kelsey-Hayes Canada Limited
 Mastic Industries Ltd.
 Metals & Alloys Company Limited
 MTD Products Limited
 Duplate (PPG)
 Reynolds Aluminum Company
 of Canada Ltd.
 SKD Company
 Slater Steel Corporation
 Stemco Canada
 Thomson Rivet Co. Limited
 Thyssen Marathon Canada Ltd./Ltée
 TRW Canada Limited

Canadian Shipbuilding and Ship Repairing Association

Marine Industrie Limitée
 Marystown Shipyard Ltd.
 MIL Davie Inc.

Canadian Truck and Trailer Manufacturers' Association

The Trailmobile Group of
 Companies Ltd.

Motor Vehicle Manufacturers' Association

Chrysler Canada Ltd.
 Ford Motor Company of Canada
 Limited
 General Motors of Canada Limited
 Navistar International Corporation
 Canada

Wood Products (Western)

Balfour Forest Products Inc.
 Canadian Forest Products Limited
 CIP Inc., Tahsis Pacific Region
 Crestbrook Forest Industries Ltd.
 Crown Forest Industries Ltd.
 Eurocan Pulp & Paper Co.
 Evans Products Co. Ltd.
 Federated Co-Operatives Ltd.
 Finlay Forest Industries Ltd.
 Groot, D., Logging Ltd.
 Groot Lumber Ltd.
 International Forest Products
 MacMillan Bloedel Ltd.
 Nechako Lumber Co. Ltd.
 Northwood Pulp & Timber Ltd.
 The Pas Lumber Company Ltd.
 Primex Forest Products
 Quesnel Forest Products
 Riverside Forest Products Ltd.
 Stuart Lake Lumber Co. Ltd.
 Weldwood of Canada Limited
 Zeidler Forest Industries Ltd.

Appendix A

Reporting Methodology

The objective of the CIPEC monitoring system is to track as closely as possible the actual changes in production energy intensity. Performance monitoring procedures and accounting methodology used by the task forces follow a prescribed aggregating method established by CIPEC in 1975.

The basis of the CIPEC method is to compare energy consumption to physical units of production, where possible. This is done by determining the difference in current year and base year energy-intensities, which is the same as a comparison of the current year consumption to the energy that would have been used in a base year (at the same level of production) before any efficiency improvements had taken effect.

The original 1972 base year was gradually modified as new companies joined the program and participating companies introduced new products. These changes resulted in a consolidated base year of 1973.

After more than a decade of CIPEC monitoring, most task forces updated individual reference years to 1985 to recognize the many fundamental changes that have occurred since the beginning of the program. Reporting of future performances will carry forward the past achievements, however, to retain the long-term trends in performance.

The quantity of energy savings claimed is calculated as the difference between the total current year energy consumption and the base year equivalent energy consumption. Each year the base year equivalent energy consumption is determined by aggregating the results of each participating company. This method of determining changes in energy-intensities thus incorporates the total effects of changes in production-mix, production volumes, technologies, and energy conservation activities.

Feedstocks used in the Chemical and Petroleum Refining industries are not included in the task force or

CIPEC accounting system since conservation of these commodities is not an issue. However, process improvements which register as site throughput reductions are regarded as conservation of energy. In the Ferrous Metal industry, the metallurgical coal that is used to make coke for steel manufacture is treated as a primary fuel input.

Since reporting began, it has been necessary to apply minor adjustments to the consumption numbers to normalize the impact of fluctuations in weather, added energy consumption from imposed environmental equipment and periodic changes in raw material quality. These corrections are done at the individual company level which often reports both gross and net efficiencies. This practice will be continued to allow participants to make future adjustments where necessary.

Appendix B

Conversion Factors

Prefix	Multiple	Symbol
kilo	10^3	k
mega	10^6	M
giga	10^9	G
tera	10^{12}	T
peta	10^{15}	P
exa	10^{18}	E

Energy	Metric	Imperial
Electricity – net	3.6 MJ/kWh	3413 BTU/kWh
– gross	10.551 MJ/kWh	10000 BTU/kWh
Natural Gas	37.2 MJ/m ³	1.00×10^6 BTU/MCF
Propane	26.6 MJ/litre	0.1145×10^6 BTU/G
Crude Oil	38.5 MJ/litre	5.8×10^6 BTU/bbl
Distillate Oil	39.0 MJ/litre	0.168×10^6 BTU/G
Residual Oil (2.5%S)	42.3 MJ/litre	0.182×10^6 BTU/G
Coal – Bituminous	32.1 GJ/tonne	27.6×10^6 BTU/ton
– Subbituminous	22.1 GJ/tonne	19.0×10^6 BTU/ton
– Metallurgical	29.0 GJ/tonne	25.0×10^6 BTU/ton
Coke-Petroleum-Raw	23.3 GJ/tonne	20.0×10^6 BTU/ton
Gasoline	36.2 MJ/litre	0.156×10^6 BTU/G
Diesel Fuel	39.9 MJ/litre	0.172×10^6 BTU/G
Kerosene	38.8 MJ/litre	0.167×10^6 BTU/G
LPG	27.1 MJ/litre	0.117×10^6 BTU/G

To Convert from	to	Multiply by
Cubic Feet	Cubic Metres	0.028
Cubic Feet	Gallons (Imperial)	6.229
Cubic Feet	Litres	28.316
Barrel (Oil)	Cubic Metres	0.159
Barrel (Oil)	Gallons (Imperial)	34.973
Gallon (Imperial)	Litres	4.546
Gallon (U.S.)	Gallons (Imperial)	0.8327
Short ton	Pounds	2000
Short ton	Tonnes	0.9072
Tonne	Short tons	1.102
Long ton	Pounds	2240
Long ton	Tonnes	1.016
Kilogram	Pounds	2.205
BTU	Joules	1055.1
Kilojoule	BTU	0.948
Gigajoule	Barrels Oil Equiv.	0.164

Notes

Photos

Captions

Courtesy

v	Heat Pump Installation	Ontario Hydro
4	Maitland Plant	DuPont Canada Inc.
8	Large Power Transformer	Westinghouse Canada Inc.
2	Tilting Furnace	Algoma Steel Corp.
4	Continuous Casting Control Room	Stelco Inc.
6	Control Room	Moosehead Breweries Ltd.
2	Construction of Subway Cars	Bombardier Inc.
5	Foundry Operation	Ford Motor Company
8	Float Glass Line	AFG Glass Inc.
4	Overhead Crane Construction	John T. Hepburn Ltd.
6	Gas Turbine Assembly	Westinghouse Canada Inc.
8	Mine Site	Quebec Cartier Mining Co.
2	Refinery Control Room Panel	Imperial Oil Ltd.
5	Thermoforming Operation	Kerwill Publications
0	Shipping Room	British Columbia Forest Products Ltd.
4	Dyeing Room	Celanese Canada Inc.
3	Body Assembly	Chrysler Canada Ltd.
2	Logging	Ministry of Industry, Science and Technology
1	Wood Storage	Ministry of Industry, Science and Technology
3	Electric Pylons	

The information, perspectives and data reported herein are solely the responsibility of the Canadian Industry Program for Energy Conservation Council and the reporting task forces.

The co-operation and support of the Business and Government Energy Management Division, Energy, Mines and Resources Canada, in the preparation of this report is appreciated.

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Canadian Industry Program for Energy Conservation

- *energy, efficiency and the environment*

1988

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V6E 2H1

November 29, 1989

The Honourable Jake Epp, P.C. M.P.
Minister, Energy, Mines and Resources
House of Commons
Ottawa, Ontario
K1A 0A6



W. Peter Torbet

Dear Minister,

Progress towards our 1990 goal of a 31% improvement over 1973 energy intensity levels continued in 1988 with an additional 0.4% improvement over 1987. This raises the total improvement since 1973 to 28.8%. While this is less than last year's 2.6% improvement and an average of 1.8% per year for the program, it does reflect the level of incentives for investment in energy efficiency improvement in 1988.

As we review the past efforts of the CIPEC program and the current energy environment, the question that continues to be raised is: "What provides the incentive for investment in energy management measures?"

In the 70's, several factors played a role – a national imperative, forecast energy shortages, the spectre of government regulation and/or quotas. They led to the formation of the CIPEC program to provide an umbrella organization to represent Canadian Industry and provide a focus for reporting and information transfer. However, there was also very strong support from market forces – significantly higher energy costs for Canadian Industry. The net result was a 15.4% improvement in energy efficiency in 1980 vs. 1973.

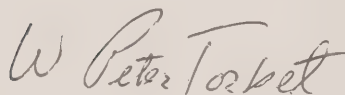
In the 80's the scene changed. Government moved away from energy regulation. Significant additional energy sources were identified. There were additional priorities for industry – health and safety, North American and global competitiveness and quality. The market forces, ie. energy prices, became significantly less influential. While these all shifted the focus away from energy management investments, 1988 energy productivity was an additional 13.4% better than that of 1980.

What do the 90's hold? The incentives are largely unchanged from the 80's with the major factor, energy prices, a dis-incentive. Without additional incentives the strong progress of the 70's and 80's will not continue. There is, however, a larger issue that energy efficiency can help address – the environment. Every discussion and consideration of this issue recognized the vital contribution that improved energy efficiency can make. Our task is to present the need as the incentive to accelerate the energy management effort.

The past year has been difficult for the CIPEC program. The suspension of funding for a 4-month period and the elimination of the programs sector of EM&R from which technical and administrative support was provided has caused industry participants to re-assess their support of the program. We have concluded that the easy decision, but also the wrong one, would be to stop the effort. In addition, recent discussions with your officials have convinced us this was the right decision and that a revitalized task force network can help respond to an environmental agenda. We believe now, more than ever, the CIPEC program is vital to provide the incentive to obtain the environmental benefits that accrue from effective energy use.

We look forward to the renewed support of your ministry as we tackle the energy/environment challenge.

Yours sincerely,

A handwritten signature in dark ink, reading "W. Peter Torbet". The signature is fluid and cursive, with the first name "W." and last name "Torbet" clearly legible.

W.P. Torbet
Chairman, CIPEC Council

The Canadian Industry Program for Energy Conservation (CIPEC) is an industry-administered/government-sponsored program for promoting and monitoring energy efficiency throughout the Canadian manufacturing and mining industries.

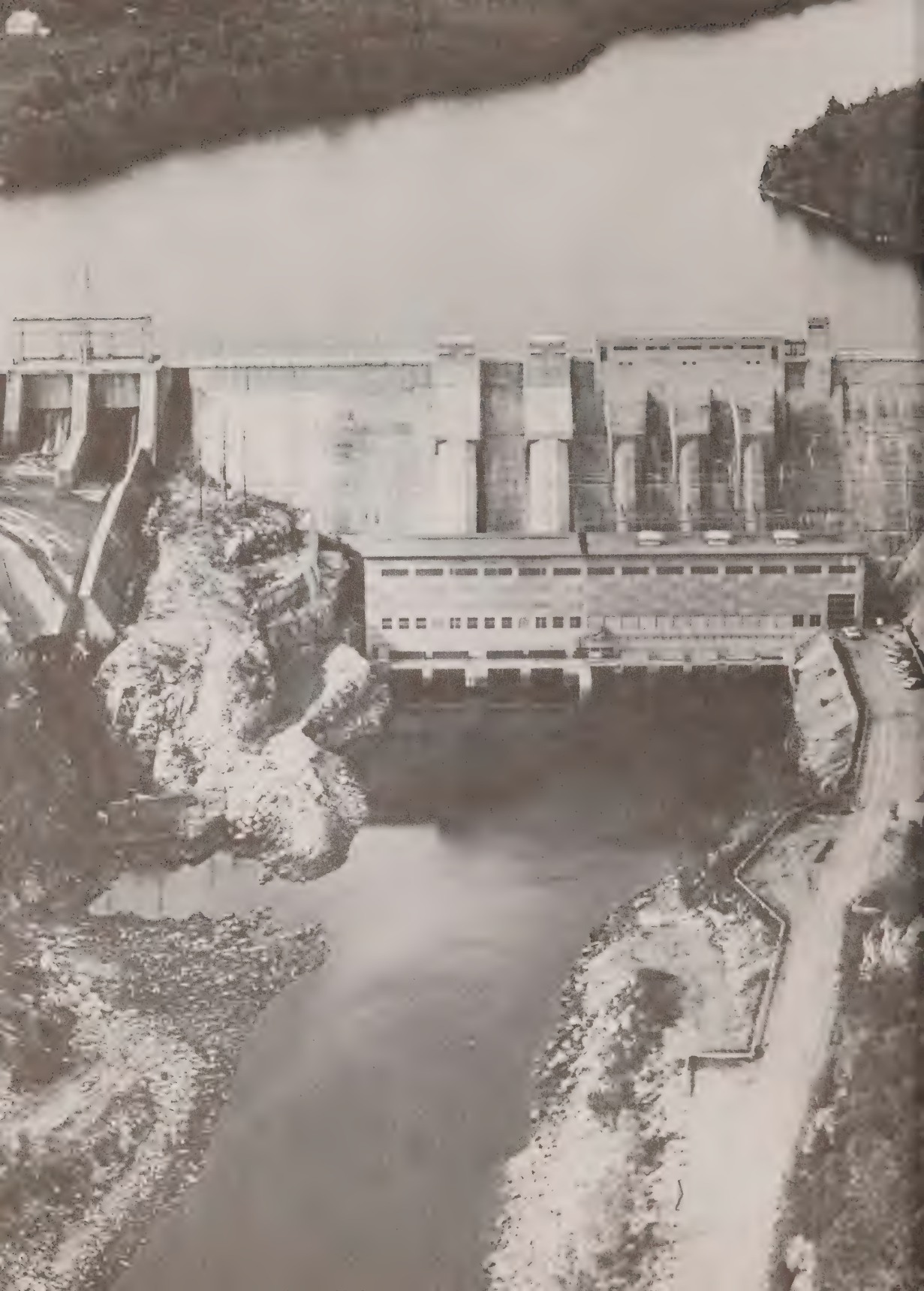
CIPEC was established on May 23, 1975, as a result of deliberations between the Federal Government Ministers of Energy, Mines and Resources and Trade and Commerce, and 50 of industry's most senior representatives. It now consists of 14 different industrial task forces that represent a broad spectrum of Canadian manufacturing and mining industries.

The program's objectives are to promote energy conservation by:

- Setting voluntary energy efficiency improvement goals;
- Reporting annually to government on issues and progress relative to achieving these goals;
- Increasing energy management awareness and techniques within industry;
- Exchanging non-proprietary energy information for common benefit;
- Maintaining effective industry-government dialogue.

Table of Contents

1988 Performance	1	Task Force Reports	
Energy Costs and Savings	6	Chemical	15
Energy Consumption and Trends	6	Electrical and Electronic	19
Natural Gas	7	Ferrous Metals	23
Refined Petroleum Products	7	Food and Beverage	27
Electricity	8	General Manufacturing	33
Coal and Coke	9	Industrial Minerals	39
Other Fuels	9	Machinery	45
Energy and The Environment	9	Mining and Metallurgy	49
Demand-Side Management		Petroleum Refining	53
Programs	11	Plastics Processing	57
		Pulp and Paper	61
		Textiles	65
		Transportation (Manufacturing)	69
		Wood Products (Western)	73
		Reporting Companies	76
		Appendix A – Reporting	
		Methodology	82
		Appendix B – Conversion Factors	83



Energy Efficiency and the Environment

88 PERFORMANCE

This year, 650 energy-conscious manufacturing and mining companies participated in the voluntary PEC survey. The energy used in these companies represents about 10% of the total consumption in the entire manufacturing and mining industries.

Energy consumption per unit of output in the surveyed companies remained relatively unchanged in 1988. The flat performance is the result of many interrelated factors, which affect each industry in different ways. In Figure 2, the performance of the 14 participating sectors is displayed together with their 1990 goals. Performance comparisons, however, should not be made between industries since each has a totally different energy intensities and potentials for energy conservation.

Energy efficiency, aggregated across all sectors, improved by 28.8%. The total improvement to date is 28.8% better than 1973 energy intensity rates and 4.7% above the new 1985 base year reference levels.

Figure 1

CIPEC Energy Improvement

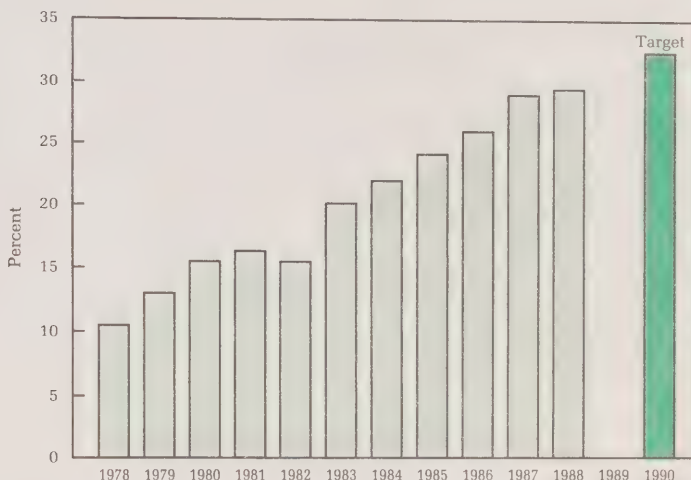


Figure 2

ENERGY INTENSITY IMPROVEMENT

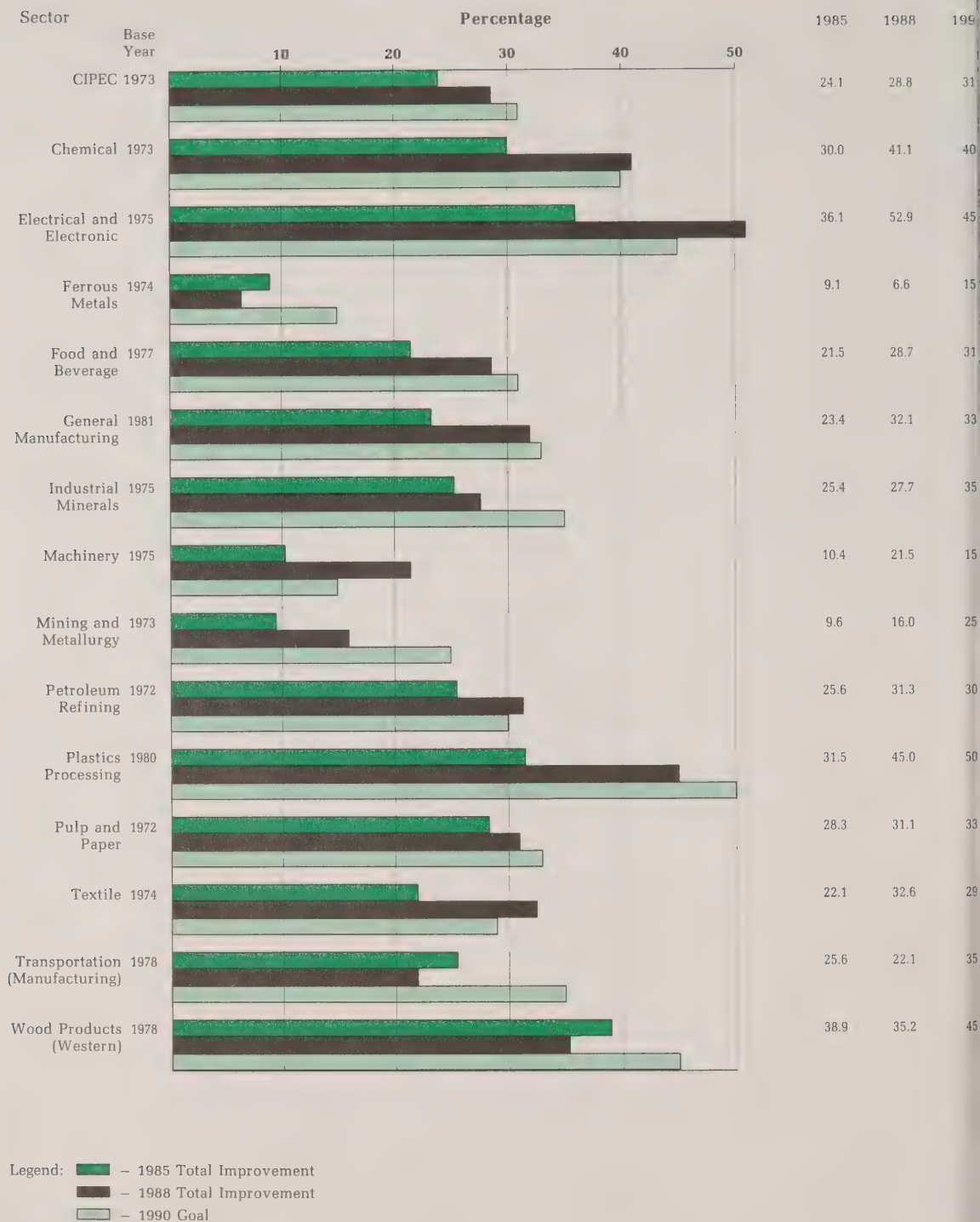


Table I

Industrial Economic Activity

(in current dollars)

Sector	GDP		Capacity Utilization		Cap. & Rep. Investment	
	(Million)	(%)	(%)	(%)	(Million)	(%)
	1988	Chge.	1988	Chge.	1988	Chge.
Chemicals	7,235	7.7	93.8	4.1	1,769	3.4
Electrical & Electronic	13,193	16.2	95.7	11.3	792	-1.7
Ferrous Metals	8,574	10.7	77.5	3.2	3,233	7.4
Food & Beverages	11,928	6.1	79.9	-7.5	1,968	9.4
General Manufacturing	2,697	5.5	68.7	-5.2	324	-13.6
Industrial Minerals	3,278	5.9	79.7	0.8	749	14.0
Machinery	4,473	14.8	81.7	6.9	526	23.8
Mining & Metallurgy	11,485	11.3	92.5	1.8	4,189	-2.5
Petroleum Refining	1,155	9.7	84.0	2.3	1,088	5.1
Plastics Processing	2,026	6.4	92.7	-3.8	668	9.8
Paper Industries	9,064	7.1	90.0	-0.3	5,324	28.3
Textiles	2,703	5.7	94.6	-1.7	396	2.8
Transportation (Manufacturing)	13,192	13.3	71.4	1.4	3,570	9.0
Wood Products (Western)	5,901	3.8	91.3	-5.1	1,568	26.4
Durable Goods Industries	60,340	13.1	80.4	2.8	n.a.	n.a.
Non-Durable Goods	44,919	6.6	87.3	0.2	n.a.	n.a.
Total Manufacturing	105,259	10.3	83.6	1.4	29,308	16.1

Source: Statistics Canada Catalogues #15-001, #31-003, #61-205.

In a strong economy, management's attention is usually directed to the needs of production, and when coupled with high capacity situations, the urgency to expand facilities. This often results in a strategy of satisfying immediate needs first and concentrating on efficiencies at a later date. Moreover, the energy efficiency of many existing plants declines when production levels are pushed to their limit. Numerous examples of this were reported in 1988.

Eleven of the thirteen manufacturing sectors increased capital spending in 1988 while spending in the mining sector decreased. Table I shows that capital investment expenditures in the manufacturing industry rose 16.1% in nominal terms

in 1988 compared to 1987 and the lion's share was spent on new machinery and equipment. But very little was directed to energy efficiency improvement projects.

Several participants indicated that energy improvements were included in capital projects only when savings provided about twice the normal economic return. New capital projects normally require 12% to 18% internal rates of return for approval (given the relatively high interest rates), but energy conservation projects often required 20% to 50% minimum return rates.

Several manufacturing sectors, including chemicals, food & beverages, plastics, paper industries, textiles and wood products, have been

Table II
Average \$/GJ

Sector	
Chemicals	4.47
Electrical	6.80
Ferrous Metals	3.21
Food & Bev.	6.64
General Mfg.	6.54
Ind. Minerals	4.74
Machinery	7.47
Mining	7.20
Pet. Refining	2.92
Plastics Proc.	8.24
Pulp & Paper	7.67
Textiles	6.64
Trans. Mfg.	6.33
Wood Prod.	7.75
CIPEC Average	4.99

Table III

Average Industrial Energy Prices

Province	Type	\$ / GJ	Annual % Increase
		1988	1980 - 1988
Newfoundland	Electrical	15.53	8.3
	Oil	8.15	7.1
Prince Edward Island	Electrical	8.30	1.8
	Oil	8.10	7.2
Nova Scotia	Electrical	13.31	4.5
	Oil	7.36	6.7
New Brunswick	Electrical	11.78	3.9
	Oil	8.28	8.3
Quebec	Electrical	9.00	4.6
	Oil	7.36	6.5
	Natural Gas	4.52	7.0
Ontario	Electrical	12.47	7.8
	Oil	8.33	8.6
	Natural Gas	3.56	5.0
Manitoba	Electrical	8.30	5.1
	Oil	8.33	8.7
	Natural Gas	2.88	3.4
Saskatchewan	Electrical	15.67	9.4
	Oil	7.33	7.0
	Natural Gas	2.46	5.0
Alberta	Electrical	8.81	6.7
	Natural Gas	1.82	4.0
British Columbia	Electrical	8.75	8.7
	Oil	2.32	7.7
	Natural Gas	7.90	4.8
Canada	Electrical	10.78	6.8
	Oil	7.85	7.6
	Natural Gas	2.82	4.7

operating above 80% total capacity since 1985. These sectors are therefore more inclined to increase production capacity over the next few years. In fact, the last four have experienced small declines in utilization rates in 1988 as new additions to the capital stock came on stream.

According to Statistics Canada, the mining sector capital investment (in construction and repairs) has remained relatively flat despite real increases in its Gross Domestic Product. The rise in output was possible

through greater use of existing operations, as indicated by a 2 point rise in capacity utilization to 92.5%.

Reduced equipment capital cost tax allowances (Class 34) and lengthened paybacks due to soft energy prices also had a negative impact on promoting energy efficiency projects.

Colder winter weather had a noticeable influence on higher energy demand and operating effi-

ciency in 1988. The temperatures during the first and last quarters were 5.9% and 7.5% colder than 1987 (based on degree-day data throughout the country). The amount of fuel required for space heating increased accordingly and contributed to record increases in demand for natural gas, electricity and coal.

Together with slow oil and natural gas price increases, the motivating factors to improve energy efficiency were weak in 1988. Average energy costs (Table II) vary considerably

Figure 3

Industrial Energy Cost Savings

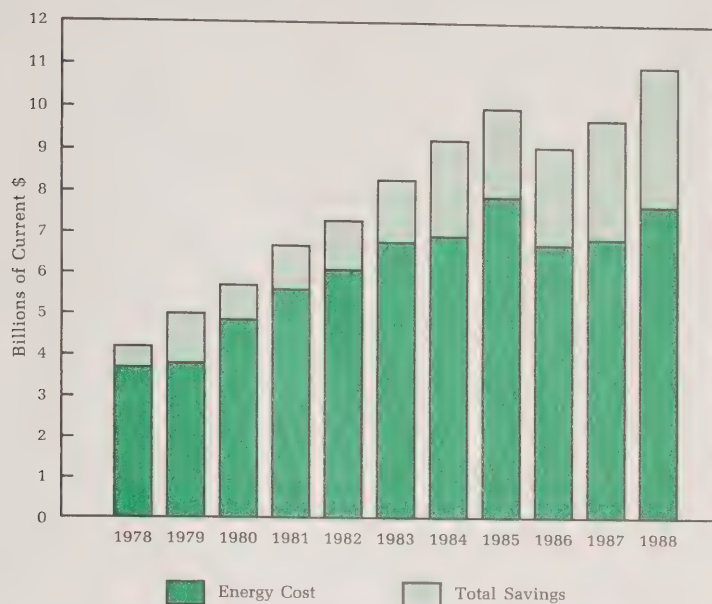


Figure 4

Distribution of Energy Costs

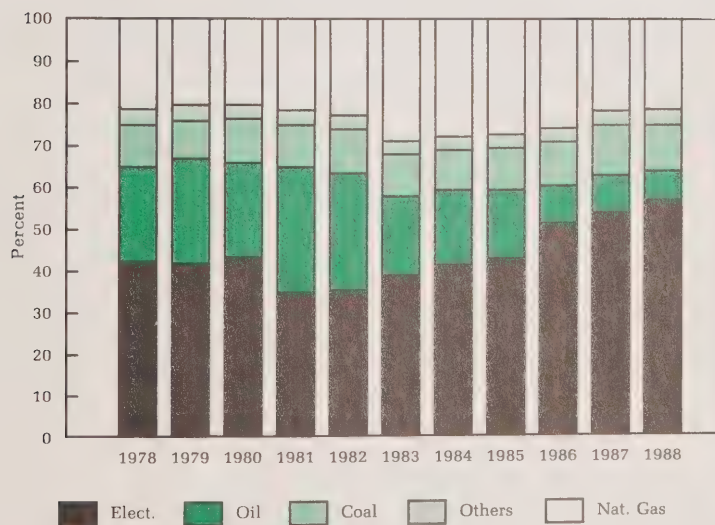


Table IV

1988 Energy Consumption, Costs, and Savings

	Energy Use ¹ (PJ)	Estimated Total Cost (\$,000)	Total Savings (\$,000)	Incremental Savings (\$,000)
Chemicals	309.89	1,384,645	968,193	21,371
Electrical & Electronic	6.28	43,175	48,589	(533)
Ferrous Metals	277.07	888,947	62,816	(12,273)
Food & Beverage	37.98	252,145	90,666	7,183
General Manufacturing	19.97	130,538	61,712	4,037
Industrial Minerals	91.47	433,500	166,500	2,836
Machinery	0.65	4,827	1,322	83
Mining & Metallurgy	135.26	973,727	185,607	37,515
Petroleum Refining	266.19	516,587	235,359	4,154
Plastics	2.67	21,993	17,978	1,292
Pulp & Paper	334.95	2,440,315	1,111,817	(43,149)
Textiles	8.24	54,733	26,471	3,493
Transportation	46.64	295,269	83,775	(584)
Wood Products	6.98	54,105	37,754	767
Total	1,544.25	7,494,506	3,098,561	26,194

(1) All sectors' electricity converted at 3600 kJ/kWh.

Numbers may not add due to rounding.

Source: CIPEC Database.

among the surveyed industries because of the different consumption patterns, use of waste materials and process technology. Average prices are also affected by the concentration of industries in certain provinces, as shown in Table III. As well, the amount of consumption also has a major impact on unit costs.

Electricity continues to be the most expensive source of energy – making it a significant target for increased energy management attention. If electrical prices continue to escalate at the same rate experienced in recent years, relative to other sources of energy, industrial energy managers will undoubtedly find the introduction of demand-side management programs useful in helping to reduce costs.

Energy Costs and Savings

Based on estimated fuel and electricity costs of \$7.5 billion among the

CIPEC participants, energy budgets would have been \$26 million higher if the 0.4% energy efficiency improvement and the effects of substitutions had not occurred. Even though the 1988 efficiency gain was marginal, the increased level of manufacturing cost savings was significant.

Total cost savings for 1988, as shown in Figure 3, amount to some \$3.1 billion based on the overall 28.8% efficiency improvement since the 1973 base year.

The estimated cumulative savings for the program now total \$22.1 billion.

For the past eight years energy cost trends shown in Figure 4 indicate that electricity's share of total costs has steadily increased while the oil share has decreased. Electricity now provides 21% of the total energy, but comprises 54% of total expense.

The total cost savings shown in Table IV for each sector are based on their respective efficiency gains to date. The incremental costs reflect the cost increase or savings achieved during 1988, depending on the reported performances.

Energy Consumption and Trends

Manufacturing and mining companies used 32.7% of the total 630 petajoule domestic secondary energy demand recorded for 1988. Primary production includes energy for export and quantities used by the supply industry itself for conversion and delivery of the amounts for secondary demand. The other major energy consuming sectors include transportation with 30% of the total, residential with 19% and commercial with 14%.

Since CIPEC monitoring began in 1978, all manufacturing and mining's energy consumption has grown by 23% (from 1,844 PJ to 2,067 PJ), mostly due to a 32% increase in production. Using the CIPEC method of calculating energy efficiency, all industry has experienced a 15% improvement since 1978. During this period, the energy consumption reported by CIPEC participants has been marginally reduced from 1,575 PJ to 1,544 PJ while their production has increased 20%. CIPEC's efficiency improvement of 18.1% since 1978 demonstrates that its participants are improving at a somewhat faster rate than non-participants.

Table VI, Distribution of Energy Consumption, presents the historical data on energy shares of total consumption for selected years. This table shows that the use of petroleum products has fallen in CIPEC participating companies, while energy from all other sources has risen. Factors contributing to these shifts include price changes and in-

Natural Gas

The natural gas share of total consumption in CIPEC companies has remained almost the same at 35.8% since 1983. Deregulation in 1985 didn't appear to have as much effect on participants' volumes as on costs, which fell by about 20%.

In the 5 years prior to introduction of deregulated gas markets in 1985, CIPEC surveys revealed only a minor direct response to the federal government's "off-oil" incentives. Most CIPEC companies were already using natural gas as their most economical fuel. Many companies now alternate with spot purchased oil to further minimize costs.

According to EMR statistics, domestic sales accounted for 45.7% of the 115.3 billion m³ net production while exports accounted for 31.2%. Some 12.2% of domestic use was converted into liquid petroleum gases while producers used 9.4% themselves. Domestic demand rose

and pipelines sectors, and greater use of natural gas by utilities for generating thermal electricity. This rising domestic demand, coupled with increasing activity in the U.S. to acquire more Canadian supplies will probably result in upward pressure on prices.

Any further significant shift to greater use of natural gas in industry will require new policies that will promote development and installation of certain technologies such as natural gas-powered refrigeration systems and cogeneration. This is just beginning to occur in some locations through utility DSM programs. Greater use of these technologies helps dampen growing electricity demand.

Refined Petroleum Products

The CIPEC participants' consumption of fuel oil appears to have bottomed out in the 11% range. The mining industry's fuel oil consumption has decreased substantially

Table V
Domestic Primary and Secondary Energy Consumption (PJ)
Showing Manufacturing and Mining Sector Use

Type	Primary Production	Secondary Demand ¹	Total Ind. Demand	CIPEC Demand	CIPEC (%)
Electricity ²	1,377	1,525	675	461	68
Natural Gas	3,921	1,883	857	590	69
Natural Gas Liquids	371	95	26	10	38
Oil Products	3,878	2,559	267	223	83
Coal & Coke ³	1,614	230	227	241	—
Steam ⁴	13	16	16	14	87
Others	—	—	—	58	—
Totals	11,175	6,309	2,067	1,597	77

Source: Statistics Canada Cat. #57-003, CIPEC Database.

¹See footnotes at end of this chapter.

incentives, availability, technology, and certain physical qualities that may provide new benefits.

9% in 1988 as a result of higher space-heating demand, increased consumption by the transportation

over the past few years, in large measure due to the use of large quantities of off-gases as fuel in a major

Table VI

Distribution of Energy Consumption (percentage)

	Electricity ¹				Natural Gas				Liquid Pet. Products				Coal & Coke				Others ⁽²⁾			
	'88	'85	'80	'78	'88	'85	'80	'75	'88	'85	'80	'75	'88	'85	'80	'75	'88	'85	'80	'75
Chemicals	12.0	27.9	24.2	17.3	60.7	51.2	54.4	57.1	5.6	4.3	14.1	24.3	0.4	0.1	2.3	—	21.3	16.5	5.0	1.3
Electrical & Elect.	36.6	33.5	31.5	27.8	57.5	63.6	57.3	48.0	3.0	1.4	9.6	24.4	—	—	—	—	2.9	1.5	—	0.2
Ferrous Metals	8.0	7.3	5.9	5.4	20.4	19.4	18.9	15.4	5.8	4.2	10.5	13.2	65.8	69.1	64.6	68.6	—	—	—	0.3
Food & Beverage	21.8	18.6	14.6	12.8	66.6	69.7	64.8	48.5	11.3	11.7	20.6	38.5	—	—	—	—	0.3	—	—	0.2
General Mfg.	33.5	28.1	26.1	n/a	49.9	60.2	52.9	n/a	9.9	11.6	21.0	n/a	—	—	—	—	6.7	0.1	—	n/a
Industrial Minerals	16.6	15.6	15.8	10.3	38.9	42.6	43.1	50.6	7.5	8.7	26.1	33.1	36.1	32.4	14.3	5.8	0.9	0.7	0.1	0.1
Machinery	38.8	37.4	24.7	23.6	52.6	54.1	41.1	22.1	8.6	8.5	30.3	51.4	—	—	—	—	—	—	1.3	—
Mining & Metallurgy	34.5	41.2	39.5	35.1	40.5	25.2	18.6	12.4	16.2	23.5	36.5	48.0	8.6	9.9	4.5	4.4	0.2	0.2	0.5	—
Petroleum Refining	14.1	4.6	3.6	3.5	16.3	24.3	12.9	12.5	6.3	6.7	23.7	22.9	20.1	19.6	15.1	16.7	43.2	44.7	44.7	44.4
Plastics Processing	50.9	43.2	33.4	23.7	44.2	51.4	63.5	43.5	4.9	5.4	3.1	31.9	—	—	—	—	—	—	—	—
Pulp & Paper	47.9	44.9	29.1	24.9	26.7	26.1	25.5	18.3	23.4	25.8	41.3	52.7	1.5	2.9	3.0	3.6	0.5	0.3	1.0	0.3
Textiles	35.1	29.1	22.0	20.1	54.9	55.0	27.2	29.1	9.9	15.8	49.1	49.9	—	—	—	—	0.1	0.1	1.7	0.9
Transportation (Mfg.)	31.5	30.1	23.6	23.0	57.9	55.2	49.5	42.1	3.5	3.7	16.2	31.0	7.1	11.0	11.1	3.1	—	0.6	—	0.4
Wood Products	47.0	48.0	43.6	n/a	53.0	52.0	45.3	n/a	—	—	11.1	n/a	—	—	—	—	—	—	—	—
Totals	22.8	19.1	18.5	14.6	34.9	32.3	31.0	27.9	10.6	17.6	24.3	32.0	19.0	19.2	17.1	17.8	12.7	11.8	9.1	7.7

Footnotes:

(1) All sectors' electricity converted at 3,600 kilojoules/kWh.

(2) Other fuels include purchased steam, plant wastes, process by-products, miscellaneous fuels, but excludes wood wastes used in the Pulp and Paper and Wood Products sectors.

Source: CIPEC Task Force Reports.

oil sands processor.

Compared to 1987 and 1986, many of the manufacturing sectors show marginal increases thought to be the result of lower oil prices. Unfortunately for the environment, much of this oil has a high sulphur content that contributes to acid rain.

EMR statistics indicate domestic demand for petroleum⁵ from all sectors of the economy increased 5.4% in 1988 from 248.9 to 262.4 thousand m³/day. High peaks in electrical demand force utilities to bring thermal generating stations on-line. Thus, fourth quarter domestic demand and imports of heavy fuel oil were higher than in previous quarters. Similarly, the bulk of the diesel fuel increase of 5.5% is attributed to the high rate of activity in the mining sector during 1988.

Since world oil prices are expected to remain somewhat the same

well into the 1990's, and gas costs are expected to accelerate because of increasing demand, some movement back to oil should be expected.

Electricity

Demand for electricity in the surveyed companies continues to grow by about 1% per year. CIPEC electrical growth is somewhat lower than the total industry increase of 4% which includes several thousand small and diverse firms that are generally too small to practice organized energy conservation. By comparison, residential electricity consumption increased by 5.8% and the commercial sector's demand rose 7.5%. Electricity now provides 20.9% of the total reported power but accounts for about 54% of the total energy cost.

The general shift towards greater use of electricity continues in nearly all surveyed industries. The trend

seems to be greatest, as shown in Table III, in those industries that are more manufacturers than extractor and processors of natural resources. The apparent drop in the chemical industry is due to large scale increases in petrochemical operations which are major gas consumers.

In different industries, shifting consumption patterns occur for many reasons. The general reason, however, includes application of new electro-technologies, emphasis on fuel conservation and recovery of wastes, response to oil substitution incentives, impact of deregulated gas markets, etc.

For example, in Quebec, where 75% of total power is generated from hydro sources, overall demand increased because of the attractive steam boiler conversion incentives provided by Hydro Quebec 5 years ago. Many end-users, especially in the pulp & paper and textile industries,

ries, switched back to oil in 1988 when the difference between oil and electrical prices increased.

Coal and Coke

Domestic demand for coal increased by 8.5%, from 50.1 megatonnes to 54.4 megatonnes, due again to higher rates of thermal electricity generation.

Coal is used primarily in Ontario by utilities and by the steel and cement manufacturing industries. The cement manufacturing sector continues to use large quantities of coal but has, in some instances, switched to discounted natural gas. The largest cement manufacturer is continuing its investigation into cheaper sources such as municipal refuse.

Lime injection scrubbing systems, bagging combustors, irradiation cleanup methods, and fluidized bed combustion systems can all contribute to lower sulphur dioxide emissions in coal-burning processes. Unfortunately, these environmental safeguards often result in increased energy consumption, which exacerbates the economics of retrofit projects.

Other Fuels

The "other" category includes a diverse mix of wastes, process by-products and miscellaneous fuels used mainly by the chemical and petroleum refining industries. The large amount of hog-fuel and pulp liquor used in the pulp and paper industry, as well as large quantities of hog-fuel used in the wood product industry are not included in this category because of the difficulty measuring heat content and quantities.

Occasionally, the use of these "wastes" changes when their resale

value exceeds their replacement fuel value. A recent example of this phenomenon is the increased sales of by-product hydrogen.

Since many of these fuels are generally free sources of energy, industry has currently fully utilized this option. Constraints on greater use of waste fuels are the availability of steady supplies and technological problems associated with materials handling and combustion.

Energy and the Environment

Since the start of the industrial revolution, increasing consumption of fossil fuels has accelerated the release of the so-called "greenhouse gases" into the environment. Scientists have studied the extent of damage caused by these gases and predict that serious consequences will arise if drastic actions are not taken soon.

Industry is a major contributor to this problem. But industry also has the capability to take remedial action through energy conservation efforts.

Last year's annual report theme – ENERGY AT THE CROSSROADS – implied that the importance of energy conservation has reached a minimum level. Now, energy conservation has taken on a new dimension in this era of ecological responsibility.

Industrial energy conservation is no longer just a means of reducing operating costs for competitive reasons, but also a major way to help improve the environment.

In recent times there have been considerable increases in the emission rate and concentration of the so-called greenhouse gases (carbon dioxide, methane, chlorofluorocarbons, nitrous oxide and ozone) into

the atmosphere. In the past ten years, the global average annual increase in atmospheric CO₂ concentration alone has risen significantly from about 315 ppmv to 350 ppmv. Scientists now believe the safe limit is well below 500 ppmv. The carbon dioxide gases are an environmental hazard because they trap the reradiation of ultraviolet rays which cause the global warming phenomenon. Other greenhouse gases combine with atmospheric moisture to form acid rain. It is also known that chlorofluorocarbons (CFCs) are destroying the earth's protective ozone layer.

The significance of the gas buildup in the atmosphere is enormous. Apart from the global damage that will become more evident as time passes, electric utilities are already starting to see the impact of the warming trend. It has been estimated by the Electric Power Research Institute (EPRI) that an average global temperature rise of less than 1°C over the next 25 years may cause local increases in peak power requirements by 10 to 20% beyond normal growth patterns in some locations such as North America where significant air conditioning and refrigeration equipment is used.⁶

Carbon dioxide is thought to be responsible for about half the projected global warming⁷ with N₂O adding an extra 8% to the greenhouse effect. Moreover, it is also thought that about one half the natural and man-made (anthropogenic) emitted CO₂ is retained in the atmosphere (the other half being absorbed into the oceans and plant life).

For global preventative measures to have any effect, new emission standards will need to be adopted on an international scale. However, it is clear that the environmental impact is not, and will not be distributed equally. For this reason, agreeing on emissions limitation will prove difficult. For example, if the

aim were to limit global emissions to current levels but allow developing nations to expand their economies to feed their growing populations, this situation would require a massive reduction from the already highly industrialized countries.

To this end, the Soviet Union and the United States have already taken major positions of leadership in R&D and reduction of greenhouse gases. These two countries transfer 45% of the total quantity of carbon into the atmosphere from fossil fuel each year⁸. In 1985, the Soviet Union emitted approximately 1.0 billion tonnes while the U.S. added about 1.3 billion tonnes from industrial processes, electric power generation and transportation in about equal proportions. Accordingly, the Soviets and Americans have decided to collaborate on efforts to look at energy use and its impact on the environment in a totally new way. Their "end-use approach" now intends to focus more effort on certain key areas by:

1. Improving performance of electric generation systems and devices;
2. Developing advanced integrated energy technologies;
3. Setting new building construction standards mindful of the growing need for better indoor air quality;
4. Improving industrial energy efficiency;
5. Incorporating energy conservation into strategic macroeconomic planning;
6. Promoting renewable energy sources;
7. Adopting least-cost energy planning.

This overall plan could well serve as the priority for actions in other industrialized nations. The U.S. National Energy Policy Act of 1988 has already led to a flurry of political activity in which a number of bills to establish strategies and goals cover the following:

- Imposition of CO₂ emission standards on power plants
- Legislation of national goals for reducing CO₂ emissions by
 - 20% in 2000
 - 50% in 2015
- Promotion of energy efficiency
- Research and development of non-fossil fuel energy sources
- Expediting approval of new natural gas pipelines

Comparable actions that affect industry are being initiated in Canada. For instance, the federal government, through its 1988 ENERGY OPTIONS study began to look at various options and their impact on the whole economy. Subsequent task force studies on electricity conservation and acid rain in Ontario⁹, for example, and ministerial meetings to discuss possible CO₂ reduction targets show some progress in this field.

There are several mitigation strategies to control and/or retard

Table VII

**Canadian Industrial Greenhouse Gas Emissions
Reductions due to Energy Conservation and Substitutions
(tonnes X 10³)**

	Estimated Emissions ¹²		No changes in efficiency or 1980 fuel mix ¹³	Reductions due to		Net Reduction
	1980	1988		Energy Mix ¹⁴	Effic. ¹⁵	
CO ₂	37,146	55,853	56,864	(9,468)	10,478	1,010
SO ₂	749	539	1,147	507	101	608
NO _x	213	244	326	36	46	82
CO	34	49	52	(6)	9	3
CxHy	13	6	20	13	1	14
Totals	38,156	56,692	58,409	(8,918)	10,635	1,717

¹²See footnotes at end of this chapter.

the build up of CO₂ in the atmosphere. Massive reforestation is one technique proposed by several responsible groups. It has been estimated¹⁰ that to absorb 5 billion tons of global carbon emitted CO₂ every year from fossil fuel combustion would require planting 7 million square kilometres of trees – an area the size of Australia. Enhanced energy conservation can also result in significant reductions.

Since the energy producing sector itself is a major contributor to the emission of greenhouse gases, industry's efficiency in using electricity, for example, has an important indirect impact. Based on the total electricity and fossil fuel used by Canadian industry, it is estimated¹¹ the differences between the emission of greenhouse gases in 1980 and 1988, shown below in Table VII, and the amount that would have occurred had there been no energy efficiency improvement (as reported by CIPEC) provide significant environmental as well as economic benefits.

This study found that 66% of the 1.5 million tonnes of greenhouse gases emitted were caused by generating electricity with fossil fuels. According to Keepin and others¹⁶, carbon laden gases released from conventional generating plants fired with coal, oil and natural gas are 0.75, 0.62 and 0.43 Gt/TWyr, respectively. Combustion flue gases usually contain 12-15% carbon dioxide.

Of the total 489 teraWatt-hrs of electricity generated in Canada in 1988¹⁷, 461.3 tWh went to final domestic consumption. Manufacturing and mining used about 42% of this available amount. Nearly 62% was generated from non-polluting hydro sources (mainly in Quebec, British Columbia and Newfoundland), while 16% was nuclear generated at about 50% efficiency. Conventional thermal plants, operating in the 30% efficiency range, gener-

ated 22% of the total power. Distribution losses amount to about 5% of the total power generated.

In generating electricity from fossil fuels, the energy conversion ratio is about 5 to 1. This ratio includes all losses from combustion, equipment losses, distribution losses, etc. For every kilowatt-hour reduction at the point of end-use, some 0.6 kg (1.2 lbs) of coal, or 0.5 liters (0.10 gallons) of light fuel oil, or 0.48 m³ of natural gas is not used by the generating utility. As well, for every kilowatt-hour reduction, over 2 pounds of CO₂ emitted from a pulverized coal station (equipped with scrubbers), 1.6 pounds from a conventional oil fired station, or 1.1 pounds from a natural gas fired station is avoided. Clearly, more energy management attention should be directed to limit the growth of electricity consumption in the future.

Demand Side Management Programs

Another important new development appearing on the industrial energy management scene is the "Demand-Side Management" (DSM) programs being offered by various electrical utilities throughout the country.

High load growth over the last few years has been rapidly eating up reserve capacity. As well, new emphasis on "least-cost" strategies has led to formation of DSM programs which postpone the requirement for expensive new facilities. The essential techniques in DSM programs include peak clipping, valley filling, load shifting, and strategic conservation (increased efficiencies, cogeneration, small hydro generation).

Now that the environment has also become a major issue, the priority of traditional DSM programs is being turned around to place more emphasis on strategic conservation actions which offer distinct environmental benefits.

The mix of appropriate techniques and incentives, however, varies in each sector (industrial, commercial and residential) because of the different load patterns and potential for conservation. The level of these incentives is often a subject of intense debate.

For example, the Ontario Ministry of Energy in its review of Ontario Hydro's Draft Demand/Supply Planning Strategy suggested that "Ontario Hydro should not *a priori* rule out paying incentives up to full cost of the demand reduction measure for some programs" (p.iv). Later, in Ontario Hydro's annual rate hearing, the Ontario Energy Board heard evidence that, "Hydro's plan appears to reflect an approximate average (incentive) cost of \$400-\$500/kW of load reduction and shifting in the 1989-1993 period. This figure is well below the utility average avoided cost associated with demand management measures which, according to Hydro's own assessment, is about \$1,000/kW, with individual measures valued at up to \$3,000/kW" (p.269).

Undoubtedly all utilities are developing plans according to means and strategies deemed most appropriate in their respective areas.¹⁸

Energy Efficiency and the Environment – Footnotes

¹ Fuel and electricity consumption figures may not correspond exactly due to difference in supply-side and end-use accounting practices, different treatment of miscellaneous energy, feedstocks and wastes, as well as non-participation of small companies in CIPEC.

² Net 3600 kJ/kWh electrical conversion rate used. Secondary demand includes electricity generated from fossil fuels, but omits conversion and transmission losses integral to the generating system. Producer consumption and non-energy uses of fuel are also not included.

³ CIPEC accounts for much of the coal used in the steel industry as fuel. From the total coal available, manufacturing used 1.4 TJ and utilities used 954 TJ to generate electricity. 182 TJ were used to manufacture coke for general use.

⁴ Some CIPEC participants sell steam generated from processes and cogeneration.

⁵ Petroleum is defined as crude and equivalent plus gas-plant ethane, propane and butanes.

⁶ "The Politics of Climate", EPRI Journal, Electric Power Research Institute, June 1988, Pg. 14.

⁷ Global Greenhouse Warming: Role of the Power Generation Sector and Mitigation Strategies, Ian M. Torrens (Director Environmental Control Systems), EPRI, Palo Alto.

⁸ Policy Options for Stabilizing Global Climate, ed., D.A. Lashof and D.A. Terpak, Draft Report to Congress, U.S. Environmental Protection Agency, Feb. 1989, P. 11-14.

⁹ Electricity Conservation and Acid Rain in Ontario, a study by Marbek Resource Consultants Ltd. for the Ontario Ministry of Energy, March 1989.

¹⁰ "The Prospect of Solving the CO₂ Problem Through Global Reforestation.", G. Marland, U.S. Dept. of Energy, Report M.DOE/Nbb-0082, Feb. 1988.

¹¹ Greenhouse gas estimates prepared by Enertec Consulting Ltd. for the CIPEC report. Methodology available upon request.

¹² Emission factors from Erwin Ponitz, Energieverwertungsagentur (Austria), 1984; M.J. Grubb, paper in IEA/OECD Expert Seminar on Energy Technologies for Reducing Emissions of Greenhouse Gases (Proceedings), Paris, 1989, Vol I, P. 554; and Dr. R.L. San Martin (DOE), Proceedings for the same expert seminar, Vol I, P. 260.

¹³ Emissions that would have occurred had there not been any efficiency improvements or changes in energy mix since 1980.

¹⁴ An increase of 8.9 million tonnes of gases occurred due to increased fossil fuel consumption and additional consumption of electricity. Thermal generating stations consume as much as three times the amount of energy they produce due to conversion efficiencies of about 30% and other distribution and transmission losses.

¹⁵ Aggregate industrial efficiency improved 15.5% between 1980 and 1988, based on CIPEC efficiency performance data.

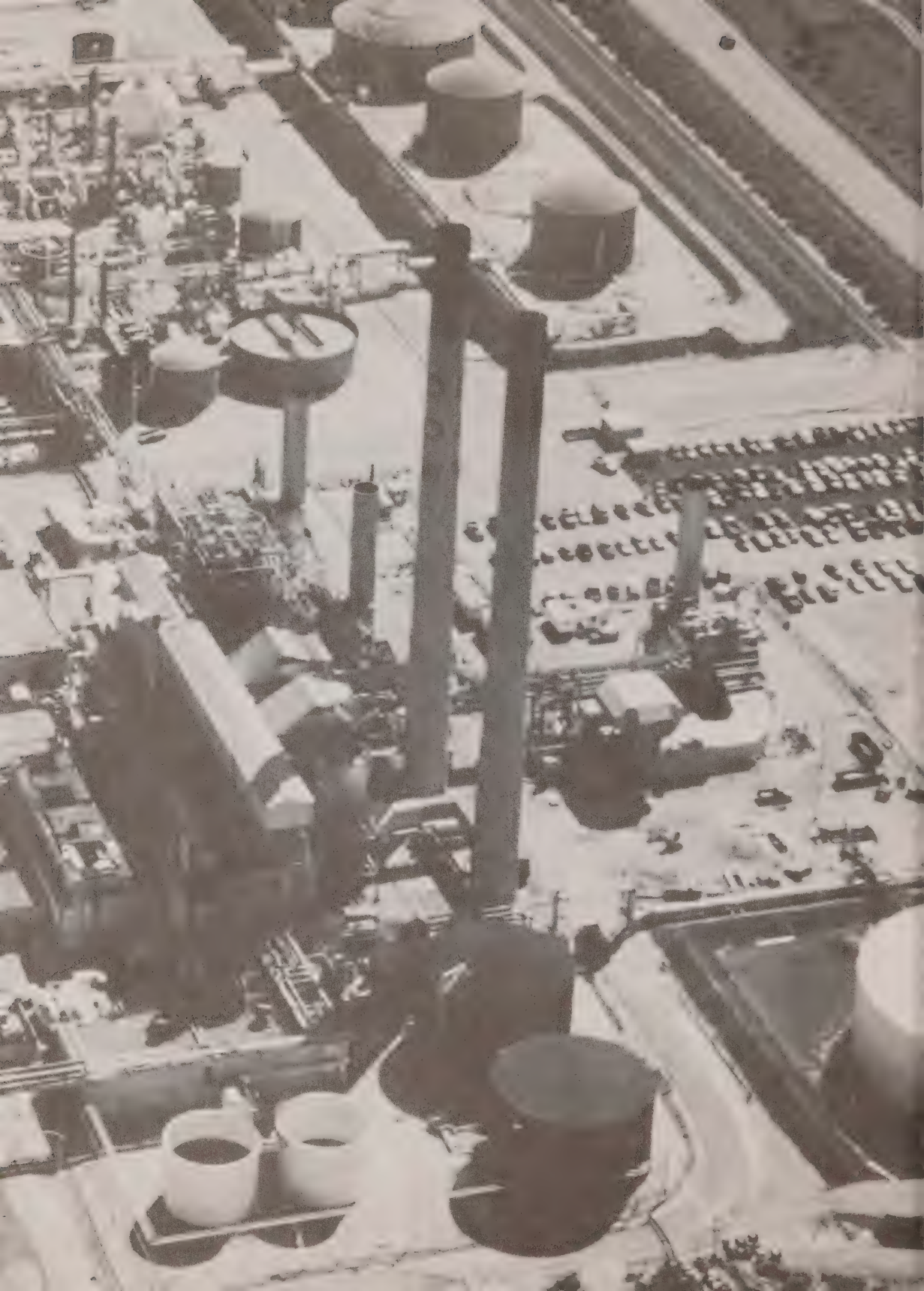
¹⁶ "Emission of CO₂ Into The Atmosphere", W. Keepin, I. Mintzer, and L. Krisoferson, SCOPE 29, Chichester, UK. (John Wiley and Son) 1986, p 35-91.

¹⁷ Statistics Canada Catalogue # 57-003.

¹⁸ For details of DSM programs in each province contact: EMR, Planning, Analysis and Legislation Branch, 580 Booth Street, Ottawa K1A 0E4, and request the publication Demand Side Management in Canada.



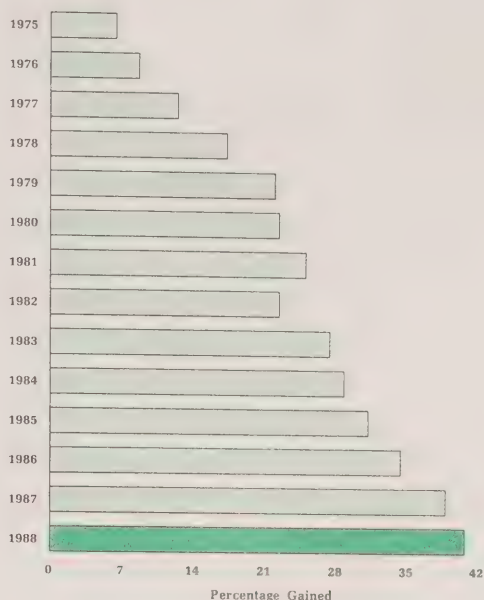
Photo – Maitland Plant
DuPont Canada Inc.



Chemical Industry

Energy Conservation Task Force

Dr. David Shearing
Chairman



General Overview

Energy usage and conservation in the chemical industry is monitored through an annual survey of member companies of The Canadian Chemical Producers' Association (CCPA). These companies produce a broad range of petrochemicals, inorganic chemicals and organic and specialty chemicals for domestic and export markets. Plant sizes vary from large-scale integrated facilities to smaller units that produce for particular markets.

This survey covers a range of companies including those spending less than \$100,000 for fuel and electricity to those spending over \$200 million on energy and feedstock. It is estimated that these corporations account for 85% of the total chemical sector's energy requirements, which in turn constitutes about 14% of the energy usage of the Canadian manufacturing industry. The survey figures exclude all forms of feedstock.

1988 PERFORMANCE

The surveyed companies improved their energy per unit of production

by 1.5% during 1988. Aggregate energy-intensity has been lowered to 11.1% compared to the new 1985 base year levels and 41.1% compared to the aggregate 1972 reference year levels.

As a result, the industry has not only surpassed its 1990 improvement target of 40% set in 1985, but has also added \$21.3 million efficiency related cost savings to the accumulated amount which now totals about \$968 million since 1972.

Factors Affecting 1988 Performance

Excellent business conditions prevailed throughout 1988 which had a beneficial effect on energy performance.

Capacity utilization increased 4 percentage points to a high of 93%, according to Statistics Canada. High capacity utilization can have different effects on chemical processors. While many electrochemical processes operate most energy efficiently at top capacity, many of the petrochemical and organic processes are designed to peak at two-thirds

to three-quarters capacity. Some references to sluggish energy efficiencies from some petrochemical operations at top capacities were noted in this year's survey.

Examples of Technological Improvements

In addition to the general economic factors that helped performance, there were many diverse technological improvements that are worth reviewing to demonstrate how the emphasis of various conservation programs have changed since monitoring began.

For example, in 1975 energy committee actions, HVAC improvements, upgraded insulation, attention to combustion efficiencies and housekeeping actions were reported as the initial focus of organized attention.

By 1980, reports of retrofits based on updated technical audits, switching to digital instrumentation, additional heat recovery and more sophisticated performance monitor-

ing on desk-top computers were made on many questionnaires.

In 1983 and 1984, fuel substitution projects constituted the main effort. There were also renewed efforts to improve combustion efficiencies to dynamically balance steam systems, accelerate changes in process technologies and debottleneck operations.

By 1985, pinch technology studies of heat exchange systems and computerized simulation analysis were being used as the basis for process optimization. Installation of electric boilers in Quebec was frequently mentioned as a result of attractive Hydro Quebec marketing incentives. Deregulation of natural gas markets

set off a whole new wave of technical and management solutions including better techniques to schedule production.

In 1988, many large "direct customer" plants in Ontario were introduced to Time of Use (TOU) electric rate structures. One company found it advantageous to replace its electric boilers with new equipment fired by natural gas. Another new development is the fact that companies are starting to go after low-grade sources of waste heat.

As usual, a great variety of projects with excellent savings were again reported in this year's survey. For example, enclosing a shipping dock at a cost of \$40,000 is expected to

save \$100,000 per year. Installation of a \$40,000 furnace air preheater system will provide savings of some \$31,000 per year. Major upgrading of a plant air compression system costing \$325,000 and a \$100,000 conversion of a gas dryer system will yield a payback of about one year.

One company reported spending \$600,000 on 22 equipment and instrumentation related upgrades that are expected to yield over \$860,000 annually for a 10 month cost recovery period. In this company, identification and implementation of a large number of annual energy conservation retrofits has always been a routine activity.

Table I

Chemical Industry Energy Efficiency Improvement

Current year (1988) total energy inputs	381.713 petajoules
Base year (1985) equivalent energy inputs	428.906 petajoules
Adjustments (1985-1988)	.371 petajoules
Net Improvement	= 11.1%
Efficiency gain 1973 - 1985	30.0
1986	4.4
1987	5.2
1988	1.5
Total gain 1973 - 1988	41.1%

Errata

Subsequent to publication of the 1988 CIPEC Annual Report, it was discovered that some errors had been made under the Transportation Industry (Mfg.) Section. In order to correct the errors, please add, amend or substitute as follows:

1. Please substitute the following on the inside covering page under the heading Transportation:

Ian Hatcher
Manager, Industrial & Plant
Engineering
Allied-Signal Aerospace Canada,
Garrett Canada
255 Attwell Drive
Rexdale, Ontario
M9W 6L7

2. Please substitute the last sentence of the first paragraph on Page 70 under the heading "Future Outlook and Concerns" as follows:

"This will result in a significant improvement in our overall energy efficiency, and should put the Task Force within reach of its target of improving energy efficiency by 10% in 1990 compared to the 1985 base year."

3. Please substitute the last paragraph on page 70 under the heading "Future Outlook and Concerns" as follows:

"The Task Force believes that energy management is an issue for the 1990's – in terms of the competitive position of our sector companies, and also in terms of the effect of energy use on the environment. The CIPEC Program continues to provide a vitally needed communication tool. CIPEC's vast industrial network coupled with government participation is a vital element needed to ensure our competitive position and improved protection of Canada's environment through effective energy management.

4. In the CIPEC Report "Reporting Companies" listing, under sub-sector "Transportation (Mfg.)," please amend Bombardier Inc. and Canadair Aeronautical & Defense Group as follows:

Bombardier Inc., Groupes aeronautique
et defense Canadair

5. Please add the following Table to the Transportation (Mfg.) sub-sector report.

Table III

Transportation Industry (Mfg.) Task Force

Sector Performance
Percentage Improvement/Deficiency In Energy Efficiency Against Base Year

Subsector	Base Year 1985			Base Year 1978						
	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979
ABAC (Boating)	0.0	—	—	—	12.9	3.1	- 48.5	- 88.1	—	- 0.7
AIAC (Aerospace)	2.8	5.2	5.2	20.6	7.9	7.3	3.9	- 43.7	6.0	- 1.2
APMA (Autoparts)	4.6	3.9	2.7	6.5	13.5	11.7	5.8	26.7	15.6	3.3
CMIA (Maritime)	1.9	15.2	- 19.4	11.4	- 2.9	10.6	- 21.1	46.8	- 14.1	- 9.0
CTTMA (Truck/Trailer)	- 0.2	9.0	—	- 26.3	- 15.4	- 56.9	- 65.2	- 25.6	- 18.1	- 0.02
MVMA (Motor Vehicles)	- 6.7	- 6.6	2.0	28.8	22.8	- 6.3	3.3	—	—	—
TASK FORCE	- 3.5%	- 3.3%	2.1%	25.6%	20.3%	1.2%	3.7%	3.2%	4.5%	0.4%
(Performance to Base Year)										
TASK FORCE GOAL	◀ --- + 10% by 1990			◀ --- + 25% from 1978 to 1985						

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TASK FORCE GOAL	◀ --- + 10% by 1990			◀ --- + 25% from 1978 to 1985						

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Appendix B

Subsequent to publication of this report, it was discovered that an error had been made on the conversion tables. Please substitute the table below for the tables listed on page 83.

Prefix	Multiple	Symbol
kilo	10^3	k
mega	10^6	M
giga	10^9	G
tera	10^{12}	T
peta	10^{15}	P
exa	10^{18}	E

Energy	Metric	Imperial
Electricity – net	0.0036 GJ/kWh	3414 BTU/kWh
– gross	0.010551 GJ/kWh	10000 BTU/kWh
Natural Gas	0.0372 GJ/m ³	1.0×10^6 BTU/MCF
Propane	0.0266 GJ/litre	0.1145×10^6 BTU/IG
Crude Oil (#6)	0.0385 GJ/litre	5.8×10^6 BTU/bbl
Distillate Oil (#2)	0.039 GJ/litre	0.168×10^6 BTU/IG
Residual Oil (#5)	0.0423 GJ/litre	0.182×10^6 BTU/IG
Coal – Bituminous	32.1 GJ/tonne	27.6×10^6 BTU/ton
– Subbituminous	22.1 GJ/tonne	19.0×10^6 BTU/ton
– Metallurgical	29.0 GJ/tonne	25.0×10^6 BTU/ton
Coke – Petroleum (Raw)	23.3 GJ/tonne	20.0×10^6 BTU/ton
Gasoline	0.0362 GJ/litre	0.156×10^6 BTU/IG
Diesel Fuel	0.0399 GJ/litre	0.172×10^6 BTU/IG
Kerosene	0.0388 GJ/litre	0.167×10^6 BTU/IG
Liquid Propane Gas (LPG)	0.0271 GJ/litre	0.117×10^6 BTU/IG

To Convert from	to	Multiply by
Cubic Feet	Cubic Metres	0.028
Cubic Feet	Gallons (Imperial)	6.229
Cubic Feet	Litres	28.316
Barrel (Oil)	Cubic Metres	0.159
Barrel (Oil)	Gallons (Imperial)	34.973
Gallon (Imperial)	Litres	4.546
Gallon (U.S.)	Gallons (Imperial)	0.8327
Short ton	Pounds	2000
Short ton	Tonnes	0.9072
Tonne	Short tons	1.102
Long ton	Pounds	2240
Long ton	Tonnes	1.016
Kilogram	Pounds	2.205
BTU	Joules	1055.1
Kilojoule	BTU	0.948
Gigajoule	Barrels Oil Equiv.	0.164

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giga	10 ⁹	G
tera	10 ¹²	T
peta	10 ¹⁵	P
exa	10 ¹⁸	E

Energy	Metric	Imperial
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Please substitute the company names listed on this page under the heading "Machinery" for those listed on page 78 of the report.

Please substitute the company names listed on this page under the heading "Mining and Metallurgy" for those listed on page 79 of the report.

Machinery

ACCO Canadian Material Handling,
a Division of Babcock Ind.
Canada Inc.
BEVCO Conveying Systems
Boart Canada Inc.
Canadian Blower/Canada Pumps
Limited
Canron Inc.
Continuous Mining Systems Limited
Dominion Engineering Works Ltd.
Dresser Pump Division, Dresser
Canada Inc.
Ecodyne Limited
FAG Bearings Ltd.
Gorman-Rupp of Canada Limited
Heath & Sherwood (1964) Limited
Hymac Ltd.
Industries USP Inc.
Ingersoll-Rand Canada Inc.
ITT Fluid Products Canada, Division
of ITT Industries of Canada Ltd.
Jenkins Canada
H.G. Kalish Inc.
H.J. Langen & Sons Ltd.
M.A.N. Ashton Inc.
MacLean Engineering &
Marketing Co. Ltd.
MTD Products Ltd.
Pullmaster Winch Corporation
RMS Machinery Division, Uniroyal
Goodrich Canada Inc.

S.A. Armstrong Limited
Sanden Machine Limited
Smart Turner Limited
Sullivan Strong Scott, Division of
Strong Equipment Corporation
Valmet-Enerdry Inc.
Ward Ironworks Limited
Webster Air Equipment, Division of
Curtiss-Wright of Canada Inc.

Mining and Metallurgy

Cameco
Cominco Ltd.
Denison Mines Ltd.
Falconbridge Limited
Giant Yellowknife Mines
Limited
Hudson Bay Mining and
Smelting Co., Limited
Inco Limited
Iron Ore Company of
Canada Ltd.
Noranda Minerals Inc.
Pioneer Metals Corporation
Placer Dome Inc.
Quebec Cartier Mining
Company
Rio Algom Limited
Syncrude Canada Limited

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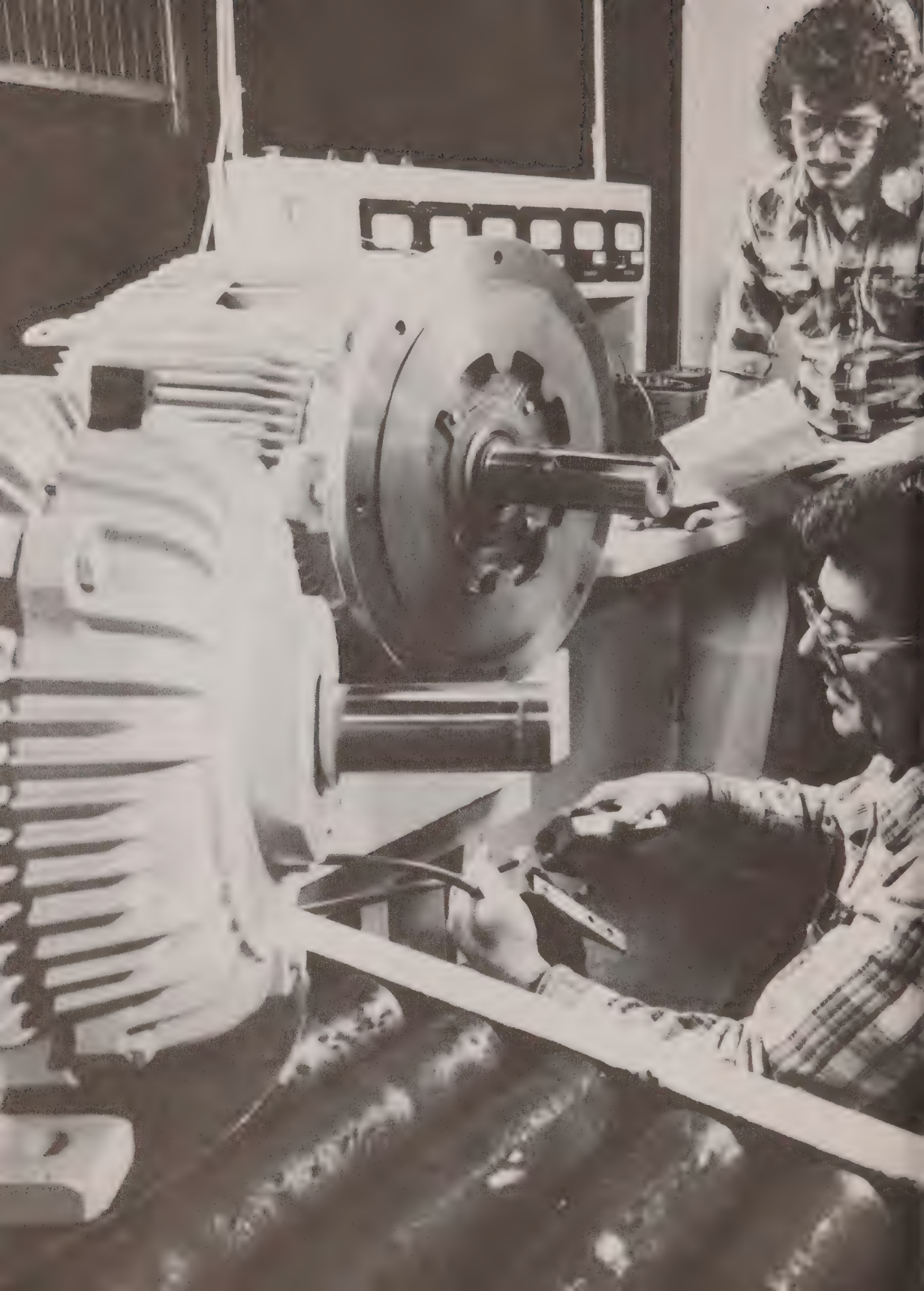
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Table II

Chemical Industry
Energy Use

<u>Type</u>	<u>Units</u> <u>('000)</u>	<u>Gigajoules</u>	<u>1988</u>	<u>1983</u>	<u>1980</u>
Natural Gas	5,057,067 m ³	188,122,902	49.3	44.4	36.8
Electricity	10,331,932 kWh	109,012,210	28.6	34.7	31.1
Liquid Petroleum Products:					
Distillate Oil	69,531 litres	2,711,712	0.7	0.9	10.0
Residual Oil	181,490 litres	7,677,043	2.0	4.2	14.4
Diesel and Gasoline	11 litres	459	—	0.5	0.4
Other Fuels:					
Propane, LPG	257,609 litres	6,852,412	1.8	1.0	—
Coal & Coke	51.7 tonnes	1,201,400	0.4	0.3	2.3
Steam	n/a	12,501,805	3.3	2.0	1.0
Other Fuels	n/a	53,632,699	14.0	12.0	4.0
Totals	— 1988	381,712,677			
	— 1987	428,905,604			

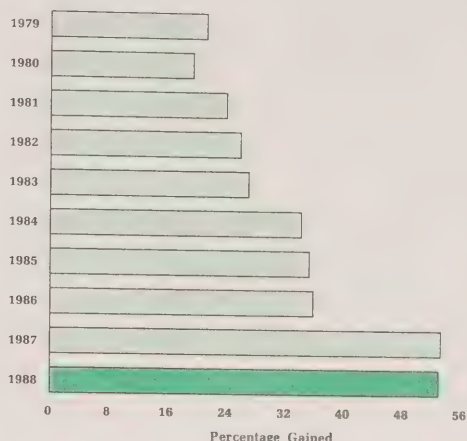
Other fuels include process by-products, vent gases, "drips", "slops", pitch, sulphur, hydrogen, waste oils, etc. Electricity is converted at 10,551 kj/kWh.



Electrical and Electronic Industry

Energy Conservation Task Force

Seth Duffus
Chairman



More than 200 companies represented by this task force manufacture a diverse range of products used in the generation, transmission and distribution of electricity. These include generators, transformers, switchgear, lighting equipment, wire and cable, and electrical appliances. A host of electronic products, systems and related high technology components are manufactured by the companies represented by this task force. Most of the companies are members of the Electrical and Electronic Manufacturers' Association of Canada (EEMAC) which acts as a secretariat for the task force.

1988 Performance

From 1975 to 1988 there has been a 53% total gain of energy efficiency. A noteworthy validation of the overall energy savings claimed can be found by comparing total shipments from the sector members, to the total energy used by those reporting to the sector task force surveys. From 1981 to 1987 shipments in constant

dollars from EEMAC companies increased by 40%, while energy consumed by task force reporting companies was reduced by 30%. This is equivalent to a 50% improvement in energy efficiency.

Forty-five (45) companies contributed to the 1987 task force report. Fifty-eight (58) companies submitted data to the 1988 report. Of these 58 companies, 25 are new contributors. That is 30% more companies participating in the 1988 report over last year. Participation is increasing as people become more involved with environmental concerns. Of the 45 companies reporting last year, 25% failed to respond to the 1988 survey. It is difficult to accurately compare the results of 1987 to the figures of 1988 due to the large number of changes in survey participants.

A 45% target for improvement in effective use of energy had been set for 1990, but at this point the target has been achieved and surpassed.

1987 was a banner year for improvement in energy efficiency. The 16.2% improvement over 1986 (shown in Table I) was attributed to new manufacturing techniques, productivity improvements, and improved survey participation. Because 1987 was such a record year, an increase in overall energy efficiency was difficult to achieve for 1988, resulting in a small setback of -1.2%.

Energy productivity rose in many individual plants because of increased operational capacity; plants operated at almost full capacity - 95% compared to 80% average in 1987. Benefits from the warmer winter were offset by the increased use of air conditioning during an exceptionally hot summer.

Energy Use Patterns

The well established trend to use electricity or natural gas in place of oil is dramatically shown in Table II. Oil has posted a steady decline to almost zero consumption. The

total energy use reported is 6,273,070 Gigajoules; 36.7% of this is electrical, and 57.6% is natural gas. There were, and still are, uncertainties in prices of energy forms – the deregulation of gas and the resulting wide selection of discount opportunities – and the yet to be determined impact of 'time-of-use billing' of electrical energy in Ontario.

Task Force Activities

Education was the driving force for the task force in 1988. A series of educational meetings including lectures and plant visits to the Canadian Centre for Occupational Health and Safety in Hamilton; the Energy from Waste facility at 3M in London; the Research Laboratory at

Ontario Hydro in Etobicoke; the Edison Centre at General Electric's new corporate headquarters; and high technology manufacturing facilities at Garrett Canada in Etobicoke.

Renewed activity in terms of survey response occurred as a result of personal contacts made by Mr. Bev Markle. He arranged plant visits to assist many of the companies with data gathering, and to communicate details of sector programs and activities.

Future Outlook – The Challenge Ahead

The outstanding progress reported from 1975 to the present has been complementary to the objectives of CIPEC; the E&E sector has played a

major part in this progress. As technological development increases in the electrical and electronic sector it provides a leading contribution in this as well as other sectors to the improved utilization of raw materials, the effective use of energy, and upgraded environmental objectives.

The task force will continue to concentrate on increasing involvement of sector companies and better survey reporting. The beneficial meeting format in 1988 has increased participation by energy coordinators. The new task force executive will continue to emphasize informative and technological presentations related to efficiency in plant operations.

Table I

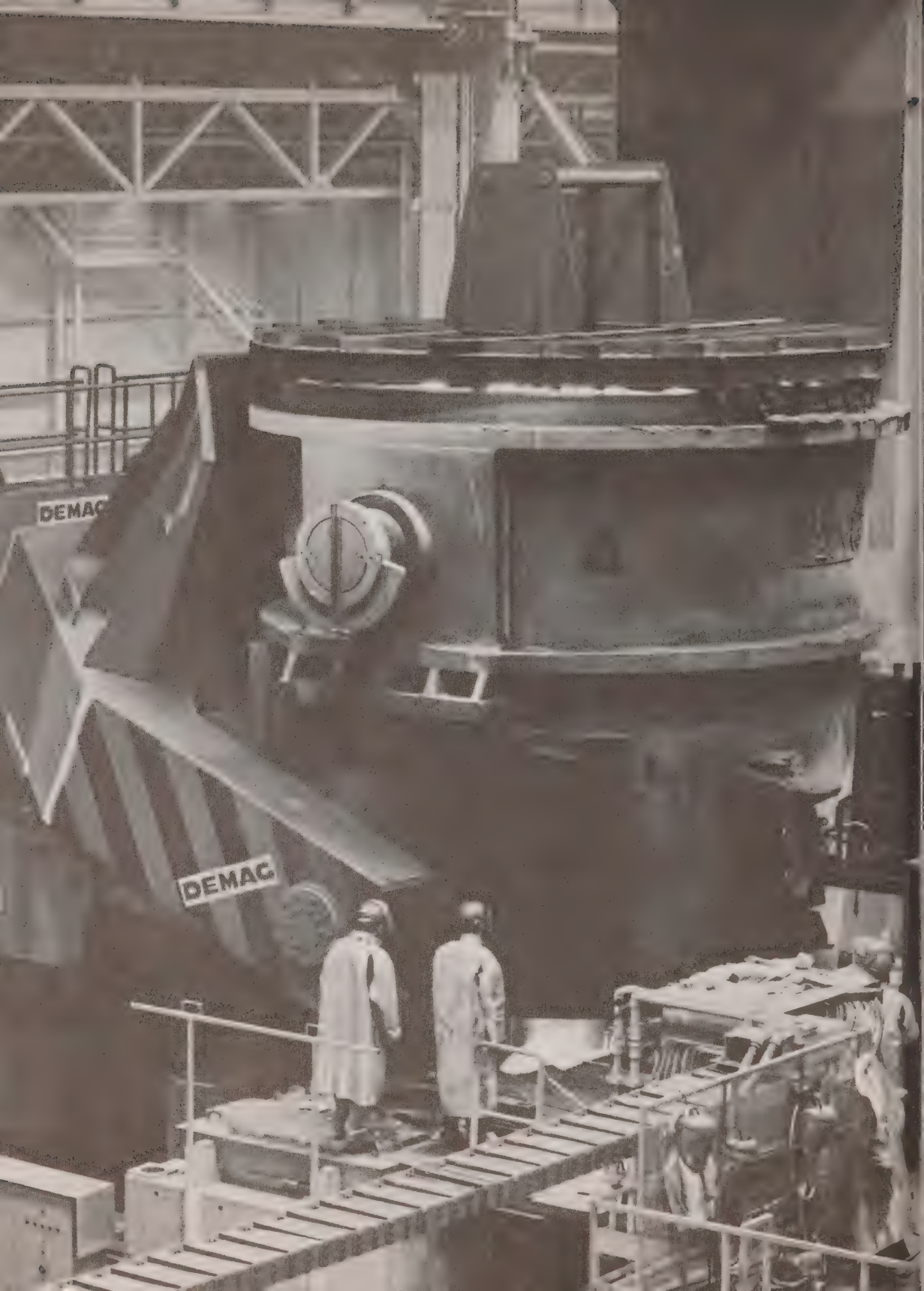
Electrical and Electronic Industry Energy Efficiency Improvement

Current year (1988) total energy inputs	6,273,070 GJ
Base year (1985) equivalent energy inputs	7,548,820 GJ
Net Improvement = 16.9%	
Adjustments — None	
Efficiency gain 1975 - 1985	36.1
1986	1.9
1987	16.2
1988	-1.2
Total gain 1975 - 1988	53.0%

Table II

Electrical and Electronic Industry Energy Use

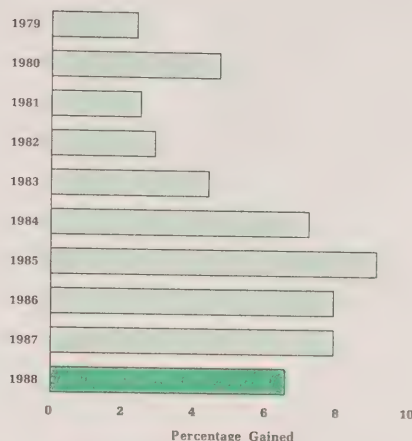
Type	Units	Gigajoules	1988	1987	1986
Natural Gas	97,978,118 m ³	3,611,306	57.6	54.8	57.3
Electricity	639,808 MWh	2,299,708	36.7	41.1	37.5
Liquid Petroleum Products:					
Distillate Oil	1,644 kilolitres	64,111	1.0	0.9	1.4
Residual Oil	1,720 kilolitres	69,651	1.1	1.2	1.8
Diesel and Gasoline	355 kilolitres	13,494	0.2	0.1	0.4
Other Fuels:					
Propane	1,302 kilolitres	34,634	0.5	1.2	0.3
Steam	101,788,700 kilograms	180,166	2.9	0.7	1.3
Totals	1988	6,273,070			
	1987	6,689,830			
	1986	5,806,412			
	1985	5,841,065			



Ferrous Metals Industry

Energy Conservation Task Force

Don W.R. George
Chairman



Task Force Description

The Ferrous Metals Industry Energy Conservation Task Force is represented by the steelmakers who comprise the Ferrous Industry Energy Research Association (FERA). The companies which provided data for the 1988 energy efficiency assessment include:

1. The Algoma Steel Corporation
2. Dofasco Inc.
3. Sidbec-Dosco Inc.
4. Stelco Inc.
5. Sydney Steel Corporation (Sysco)

Together, these companies represent about 79% of the total Canadian raw steel production and produce steel by the following techniques:

- a) blast furnace, basic oxygen and/or open hearth process
- b) direct reduction/electric furnace
- c) electric steelmaking furnace

A partial listing of steel products would include:

- structural shapes
- rails
- flat rolled products
- forgings
- fasteners
- coated steel
- castings
- tubular products
- bar products
- wire and wire products

Steel is produced and/or processed in the 33 plants operated by the member companies.

1988 Composite Energy Performance

Steel production increased in 1988 to 11,917,564 tonnes from 11,856,731 tonnes in 1987 - an increase of 0.5%.

The amount of energy consumed per tonne of raw steel was higher in 1988, at 23.19×10^9 Joules, than in 1987, at 22.87×10^9 Joules (an increase of 1.4%).

All participating companies achieved success in their plant energy conservation programs, with a number of these achievements listed at the end of this report. However, certain factors overshadowed the conservation achievements in 1988 and resulted in an increase in the composite energy rate. Some of these negative factors include:

- reduced scrap proportions in the steelmaking process
- interruptions to the normal operating pace due to major construction projects and breakdowns
- start-up and learning periods for major new steelmaking and processing equipment.
- increased purchases and processing of semi-finished steel.

Progress Towards the 1990 Energy Rate Goal

In 1988, the energy rate at 23.19×10^9 Joules/tonne was 2.5% higher than the 1985 base year energy rate of 22.63×10^9 Joules/tonne and is 10.9% higher than the energy goal in 1990 of 20.91×10^9 Joules/tonne.

Task Force Technical Activities

The Technical Committee of FERA provides opportunities for member companies to exchange information on conservation activities, as well as to become involved in cooperative projects.

A Task Group of the Committee organized and hosted a meeting of the American Flame Committee (AFC) on May 10 and 11 in Toronto. The meeting theme was "Technical Developments Applicable to Reheat Furnaces" and included such topics as:

- View factors associated with heat transfer in metallurgical furnaces
- Modelling study of burners and furnace performance for oxygen enriched combustion systems
- Combustion system improvements for increased efficiency in steel plants.

Direct contact with federal government research facilities was maintained through the Energy, Mines and Resources (EMR) observer on the FERA Technical Committee. On November 8 and 9, the committee and invited company representatives visited the National Research Council (NRC) and the Canada Centre for Mineral Presentations and discussions were held on:

- steam generating heat pumps
- blast furnace coal injection
- an overview of the CANMET research activities

The committee also compiled and distributed to member companies, eleven implemented energy conservation 'opportunities'. In addition, eight case studies on variable speed drives were submitted and reviewed.

At the board of directors level, FERA has been successful in working with Queen's and McGill Universities to obtain approval for a \$3.2 million industry/university research project entitled "Process Technology in Reheating Furnaces". The three-year project will be jointly funded by the Natural Sciences and Engineering Research Council (NSERC) and the industrial participants, Algoma, Dofasco and Stelco. In-plant and laboratory testing and mathematical modelling are expected to provide gains in energy efficiency, quality and productivity.

1988 Energy Conservation Achievements

The following is a partial listing of energy conservation achievements by task force members in 1988.

Modifications to Existing Equipment

- installed evaporative cooling hoods on steelmaking vessels.
- recovered condenser cooling water for processing into boiler feedwater.
- replaced the continuous pilot system on a BOF flare stack with an intermittent igniter system.
- installed economizer control valves to reduce gas used on cutting torches while on standby.

Operating Changes

- increased charging of hot slabs into reheat furnaces.
- purchase of nitrogen allowed shutdown of oxygen plant.

- shut down coke production facilities and grinding ball production mill.
- modified the fuel firing on blast furnace stoves to ensure a steady fuel flow.
- increased production of continuously cast product.
- increased production in electric arc furnaces.

Housekeeping and Repetitive Maintenance

- upgrading of building roof insulation.
- program to inspect and repair natural gas safety relief valves.
- steam system conservation programs (traps, leaks, insulation).

Conservation Projects for 1989

All participating companies expect to implement energy saving measures in 1989. A sampling of the more significant items includes:

- addition of a heat recovery system to a major reheat furnace
- modernization of electric arc facilities.

Table I

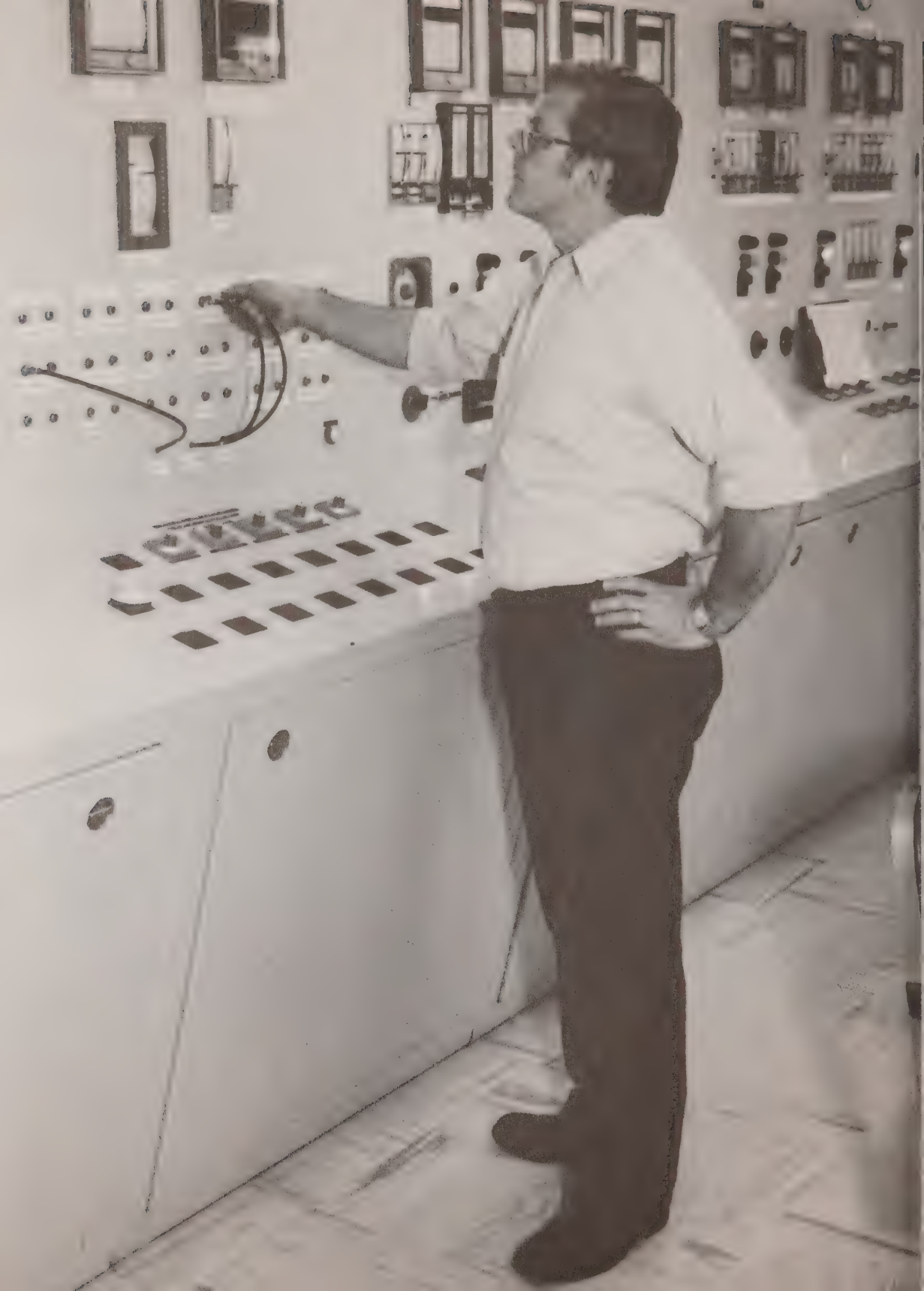
Ferrous Metals Industry Energy Efficiency Improvement

Current year (1988) total energy inputs		276,388 terajoules
New base year (1985) equivalent energy inputs		269,669 terajoules
Net Improvement	= -2.5%	
Adjustments	— None	
Efficiency gain 1974 - 1985	9.1	
1986	-1.2	
1987	0.1	
1988	-1.4	
Total gain 1974 - 1988	6.6%	

Table II

Ferrous Metals Industry Energy Use

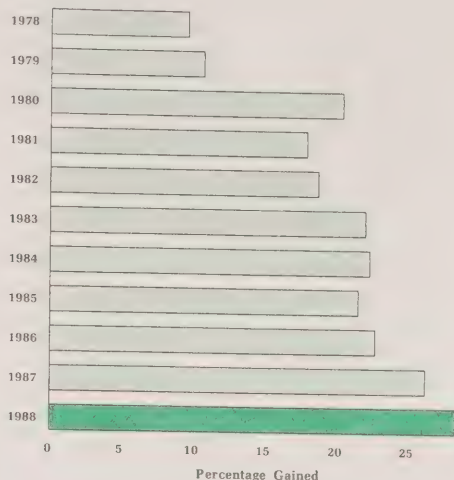
<u>Type</u>	<u>Units</u>	<u>Terajoules</u>	<u>Percentage of Total Consumption</u>		
			<u>1988</u>	<u>1987</u>	<u>1986</u>
Natural Gas	1,517,177,000 m ³	56,439	20.4	19.6	19.7
Electricity	6,167,222 MWh	22,202	8.0	7.6	7.6
Liquid Petroleum Products:					
Residual Oil	383,777,780 litres	15,543	5.6	5.1	4.6
Coal	6,282,897 tonnes	182,204	66.7	67.7	68.1
Total		276,388			



Food and Beverage Industry

Energy Management Task Force

Alexis L.W. Hyland
Chairman



Task Force Description

This report describes the energy efficiency performance of 145 companies that operate about 200 separate plants located throughout Canada. It is estimated that 42% of total energy consumption in the food & beverage industry is represented in this report. Three-quarters of the highly energy intensive companies that make homogeneous type products are represented. These include; biscuit manufacturers, brewers, distillers, and sugar manufacturers. In the more diverse sectors, coverage generally includes only the largest companies.

General Performance

Energy use per unit of production improved 2.8% during 1988 in the surveyed companies. This raises the overall improvement to 7.2% above the 1985 reference year or 28.7% over the consolidated 1977 base year. Current performance is slightly better than the 2.7% per year average rate of gain. However, not all groups registered gains, as noted in the individual reports.

Based on a total fuel and electricity cost of \$252 million, the participants' total savings are nearly \$100 million due to the aggregated performance improvement achieved

since 1977.¹ Table 1 summarizes the individual sector performances and consumption. The distribution of energy sources and consumption trends are presented in Table 2.

Task Force Events

Another well-attended energy management seminar provided up-to-date information on new natural gas contract options, electrical time-of-use rates, improving heat transfer efficiency, pinch technology analysis, steam distribution system design improvement, and submetering program monitoring techniques for the benefit of food & beverage industry representatives.

A special pinch technology demonstration study at Moosehead Breweries in New Brunswick provided an indication of the potential for heat recovery in a typical brewing operation. The study was financed by Energy, Mines and Resources Canada. Results suggest that savings of about 3% of fuel costs are economically possible.

¹ This total savings figure should not be compared with previous year's since population is constantly changing. The figure is arrived at by applying the efficiency improvement to the estimated energy costs in the current reporting period.

Group Performances

Bakeries

Energy in this sector, including Canada's largest integrated bakeries, slipped nearly 1% during 1988 because of lower production in some companies and introduction of some new brands that require slightly longer baking times. The total gain is still 5.1% better than in 1985 and a 17% improvement over 1979.

Aggregated energy intensity for the various products remains unchanged at 2,691 kJ/kg in spite of the small decline. This average energy intensity is still about 16% higher than large U.S. operations where larger economies of scale provide distinct cost and efficiency benefits. One Toronto company is well along in its plans to construct special new facilities to close this performance gap.

Baking techniques have changed in response to cost pressures and the very competitive demands of the market place. In the past, energy efficiency has been improved by decreasing baking times, minimizing refrigeration, optimizing inventories, and by some heat recovery. The next round of significant efficiency gains will probably be achieved through the use of fully integrated real-time data acquisition systems (DAS) and computerized controls.

While the impact of fuel shifts is not clear because some companies had no energy supply options, the increased consumption of electricity was a common phenomenon in all companies. The electrical power share has grown significantly from 13% in 1979 to 22% in 1988 while its share of total costs increased from 25% to 35%. This increase is due to new proofing techniques, and additional product refrigeration. Future growth levels are expected to be modest.

Biscuit Manufacturers

This survey covers 71% of all domestic biscuit manufacturing operations. There are sizable differences in energy intensities amongst the reporting companies, ranging from 5,000 to 7,000 kJ/kg of output, and in energy costs which vary between 10% to 15% of total manufacturing expense.

Energy consumption per unit of production increased 1.7% this year. In the past, the performance gains averaged the same 1.7%. No significant business reasons were evident for the reversed trend. Survey results indicate few retrofits have been installed in the past two years and that most companies are relying on basic housekeeping and maintenance activities to sustain their energy efficiencies. If these activities are relaxed, however, performance usually suffers.

Biscuit manufacturers now rely on electricity for nearly 22% of their total energy consumption and on natural gas for the remainder. Total costs are split into 24% for electricity, 56% for natural gas, and 20% for fuel oil.

The participants said their overall attention to conservation was "increasing" even though energy is still considered a "low to medium" cost factor. Two companies mentioned installing additional electrical capacitors to raise power factors and avoid cost surcharges.

Breweries

The results of 17 breweries located in each province are summarized in

this survey. Two of the largest multi-plant companies have recently decided to merge and rationalize several of the smaller facilities. The impact on energy efficiency is yet unclear. There is also a growing number of independent micro-breweries in the country that are beginning to participate in the survey results.

Energy efficiency improved 1.7% in 1988, boosting the total gain to 9.2% since 1976. The industry's average energy intensity is now down to 299 MJ/HL. The largest plants appear to operate at about twice the energy efficiency of the smallest plants. Before the trend to local micro-breweries, many small plants were built to satisfy provincial regulations for local production rather than for optimum efficiency. In general, energy expenses amount to about 7% to 15% of direct factory costs.

Even though impressive energy improvements have been made in most breweries, overall efficiencies do not show the effects of frequent shifts to higher energy-intensive brands and major changes in bottling operations. Nevertheless, this industry demonstrates its "high" regard for energy conservation by the actions it has taken recently. Pinch technology studies at Moosehead and installation of a submetering DAS system at Molson's in Toronto are two examples cited in 1988. Housekeeping activities are always mentioned as routine sources of energy conservation opportunities.

Energy substitutions and conservation completed since 1979 have had varied impacts on manufacturing costs. During this time period, additional natural gas use pushed the gas share from 55% to 66% while the heavy fuel oil consumption dropped from 18% to 3% of the total mix. Electricity's share of total consumption has increased from 18% to 27%, but its share of total cost has increased a lot more since it is a more expensive commodity.

The 9.2% energy conservation gain applied to the current energy cost of \$48.5 million amounts to a

rewarding \$4.9 million savings.

Confectioneries

While productivity was level in 1988, efficiency has gained 7.5% since the new 1985 base year and stands at 25.6% since the 1981 reference year. These gains have been achieved by extensive rationalization of operations and large-scale modernization of present plant facilities. Companies have thus become very efficient in a short period of time.

Electricity now supplies 30% of the total power and natural gas 65%. These proportions have not changed significantly in the past 10 years, suggesting that little change can be made in the basic production technologies of batching, blending, cooking and packaging.

The ice cream making process requires approximately 15 MJ/kg while chocolate production uses about 13 MJ/kg of output. Many popular products such as chewing gum require only about 2 to 5 MJ/kg of output because of their lower processing and refrigeration requirements.

The estimated energy cost of \$8 million for the group means that about one-half the total domestic manufacturing capacity is included in this survey. Energy costs usually amount to about 15% of direct manufacturing expenses in this industry.

Distilleries

The distillery industry suffered a 3% decline in energy efficiency during the year primarily due to reduced capacity utilization. The industry's output is down 5% from 1987 and 25% since 1981. Some companies have opted to take extended shutdowns for inventory adjustment, plant revisions and maintenance. Nevertheless, efficiencies are still 23% better than average 1977 operating conditions.

Distilling is a very energy-intensive process that requires large quantities of steam as the motive power. To augment the extensive retrofits made in power houses and

distribution systems, distilleries are now installing mechanical vapour recompression systems to reduce steam demand and fuel costs. Natural gas now supplies 87% of the total energy (76% of the total expense) with electricity accounting for 9.7% of the energy and 20% of the cost. The only change in the past ten years has been a 17% gain in natural gas share at the expense of heavy fuel oil.

In addition to steam and process improvements, installation of sub-metered monitoring systems indicates that operating efficiencies are watched closely.

Aggregate energy intensity is now 41,810 kilojoules per (absolute) litre of product.

Food Processors

Energy conservation in this group is complicated somewhat by the seasonal nature of production and the necessity for quick processing. Food processors generally employ extensive heating and cooling systems that require close attention to minimize losses. Some progressive companies have tried solar heating to preheat water but these systems are often feasible only with financial subsidies.

The results of this year's survey show that aggregate energy efficiency slipped 0.6% mainly because of lower production rates caused by the summer drought. The normal rate of efficiency improvement is slightly over 2% per year.

No mention of significant energy conservation improvements was made in the survey. However, one southern Ontario plant is planning to install a 5 megawatt cogeneration installation to further benefit from their low "direct purchase" natural gas costs and, at the same time, help alleviate the fully loaded electrical distribution network in that area.

Food processors have made a dramatic shift away from fuel oil to interruptible natural gas in the past 10 years. Over this period, the share of heavy fuel oil has decreased from

57% to 18% while natural gas has shot up from 20% to nearly 60%. The electricity share has remained stable near the 20% level. Where large swings in monthly gas consumption normally draw large contract cost penalties, in some cases the suppliers are receiving benefits since the summer loads offset the system winter peak. In Quebec, a few companies have installed electric steam boilers to take advantage of competitive energy pricing and the higher conversion efficiencies.

Fisheries

1988 was a good year for improved energy utilization in this sector. Aggregate efficiency went up 3.1% to boost the overall rate to nearly 30% over the reference 1978 base year level. Since this gain is moderately faster than the normal 2.8% per year rate, it is concluded that recent industry-wide rationalizations have had a positive impact.

Electricity is the dominant source of energy in shore processing operations supplying 39% of the total consumption.

Large refrigeration systems are used to make the vast quantities of ice for chilling stock-in-process and for freezing and cold storage. It is estimated that about 55% of the electrical load is used for plant refrigeration. In the Maritime Provinces, where ratchet-rate structures do not exist, any single peak demand usually sets the demand rate for the entire year. Therefore, this industry's search for higher electrical efficiencies and enhanced refrigeration technologies is a major focus of attention.

Fuel oil supplies nearly 35% of total energy, followed by natural gas with 17%. Some quantities of waste fish oil are reported as a source of energy but the majority is reprocessed and sold as fish meal and fish oil.

Energy conservation has always been treated as a "high" priority activity in this sector because of meagre profits and high energy prices, especially electricity. Survey

indications say priorities will "remain the same" in future.

Grocery Products

Companies in this sector make or process a large number of different products such as coffee, pastas, soaps, and canned and frozen foods. Those companies with extensive process heating, evaporation, and/or product refrigeration often have energy intensities near 20,000 kJ/kg. However, the majority of companies in the survey have intensities in the 10,000 kJ/kg range and therefore indicated their concern for energy was "medium and holding steady".

This group's energy efficiency improved 1.3% during the year which boosted the gain since 1985 to 4.9% and the overall improvement to 28.3% since 1978.

In the past 10 years, consumption of natural gas has nearly doubled (38% to 71%) while heavy fuel has followed an opposite trend. Much of the fuel oil used is for contract quantity optimization and for backup under interruptible gas contract requirements.

The overall electricity share has changed little from 19% to 22% even though many of the Quebec companies had switched to electric steam boilers two years ago. This year, most of the surveyed companies highlighted the increasing efforts at improving distribution and lighting systems, with transformer replacements and maintenance getting special mention. Several companies also report having to install extra line filters to deal with electrical "noise" and harmonics now that electronic equipment is ubiquitous.

Meat Packers

The meat processing industry continues to experience swings in efficiency improvement partly because of varying production levels, changing government hygiene standards, rationalization of operations, and a slow rate of investment in new equipment. After experiencing a sizeable decrease in energy performance in 1986, a gain of 5.3% was

reported in 1987, slowing to 0.7% in 1988. Nevertheless, long term performance improvement is 42.6% since 1977.

While companies' energy "house-keeping" actions often focus on waste water heat recovery and steam use, government regulators have recently tightened refrigeration requirements to preserve product quality. This, together with greater use of electrical heating in some processes, has pushed the electricity share of total consumption up in the last ten years from 18% to 29%. In so doing, it has raised the electrical cost share from 37% to 49%, making it a very serious component of energy budgets.

Larger companies are starting to introduce real-time data acquisition systems (DAS) for energy management and control. J. M. Schneider Inc., for example, is one company participating in the on-going Ontario Hydro/Ontario Ministry of Energy submetering demonstration program.

Poultry and Egg Processors

This sector includes a mix of poultry and egg processors, each with different energy requirements. For example, energy intensity for the egg and egg product processors averages about 4500 kJ/kg while the poultry processors' average is 2540 kJ/kg of product.

Energy utilization improved marginally by 0.8% in 1988 to raise the gain to 2.3% since 1985. While housekeeping activities have provided the bulk of efficiency gains to date, some HVAC, lighting, and a few major heat pump installations have helped.

Plant energy use now appears level but delivery truck fuel efficiency is getting more attention. Nearly all the respondents gave energy management a "medium and steady" priority. One large integrated company mentioned still having an energy committee in operation to sustain their conservation program.

Electricity is the dominant source of energy in this industry. Some Quebec plants are totally electric-powered. Elsewhere, plants get about one-half of their energy from electricity.

Soft Drink Producers

The carbonated beverage industry consists of many market-centred operations that make a number of popular brands under license. Energy is used mainly for building HVAC, container sterilization, filling, and refrigeration. Bottlers usually require about 3,500-4,000 kJ per litre while canners, with less clean up and sterilization, use between 1,000 to 1,500 kilojoules per litre.

This sector's energy per unit of production increased 1.5% in 1988. Since the situation was widespread, one can only speculate on the probable causes since no common reasons were cited on the questionnaires. This group is going through a strategic business reorientation where production is being concentrated into larger facilities with delivery from local terminals. It will take a little while before these new arrangements have a positive impact on the long term performance trend.

Typical energy proportions in a mixed bottling/canning plant are: 5% electricity, 35% natural gas, 30% diesel fuel, and 30% gasoline and propane for fork trucks. Natural gas, the preferred heating fuel, is normally purchased under general service contracts because annual consumptions of about 100,000 m³ are insufficient to make direct purchase arrangements viable.

Starch Manufacturers

Driven by high energy expenses and business competition, manufacturers in this energy-intensive sector raised their total performance improvement by 1.8% in 1988. The total gain since 1976 is now 34%. Based on an estimated energy cost of \$32.8 million, the saving relative to the base year is \$17 million (at current prices) which has been achieved from various improvements.

Most companies purchase their natural gas on "Buy-Sell" agreements with considerable cost savings. While the natural gas share of the total is 81%, its cost share is much lower at 64% making it the most economical source of fuel. Electricity provides 16% of the total energy but costs some 30% of the total energy expense.

Manufacture of such products as wheat and corn starch, glucose, alcohol, gluten feeds, adhesives and resins usually requires between 10,000 to 12,000 kJ/kg of product. To make some of these products, e.g. corn wet milling, it is economical to use modern electro-technologies such as mechanical vapour recompression (MVR), cogeneration and heat pumps.

One of the largest companies in the group, Casco Inc., won the Canadian Electrical Association's Regional Industrial Energy Efficiency Award in 1988 for outstanding energy conservation efforts. Casco was cited for its very efficient mechanical vapour recompression and heat pump installations. In the wet-corn milling operations, new MVR equipment more than quadrupled the original evaporation rate of 4 pounds of water per equivalent pound of steam feed to the double-effect evaporators. Two intermediate evaporators were redeployed to perform additional finishing operations. Production was thereby increased close to 30% and energy costs for evaporation were reduced by almost 50%.

The 200 HP heat pump installation is used to cool a product before shipment. The value of the recovered heat was sufficient to pay for this project within 2 years where other solutions would have provided no return.

Sugar Refineries

Performance improved 4.5% during 1988. This faster than usual rate of increase raises the operating efficiency to 7.7% over the new 1985 base year level and 36% better than original 1975 operating conditions.

Rationalizations and operation of existing facilities at higher capacities, plus implementation of energy audit recommendations account for the surge in efficiencies.

Sugar refining is a process where electro-technologies such as MVR and heat pumping have yet to be introduced. The aggregate energy bal-

ance is now 4% electricity and 96% for fuel – approximately two-thirds of which is used to generate steam for raw sugar melting and slurry evaporation. Improvement of the conventional evaporation procedure would provide significant efficiency gains judging from the experience noted in the starch companies report.

Wineries

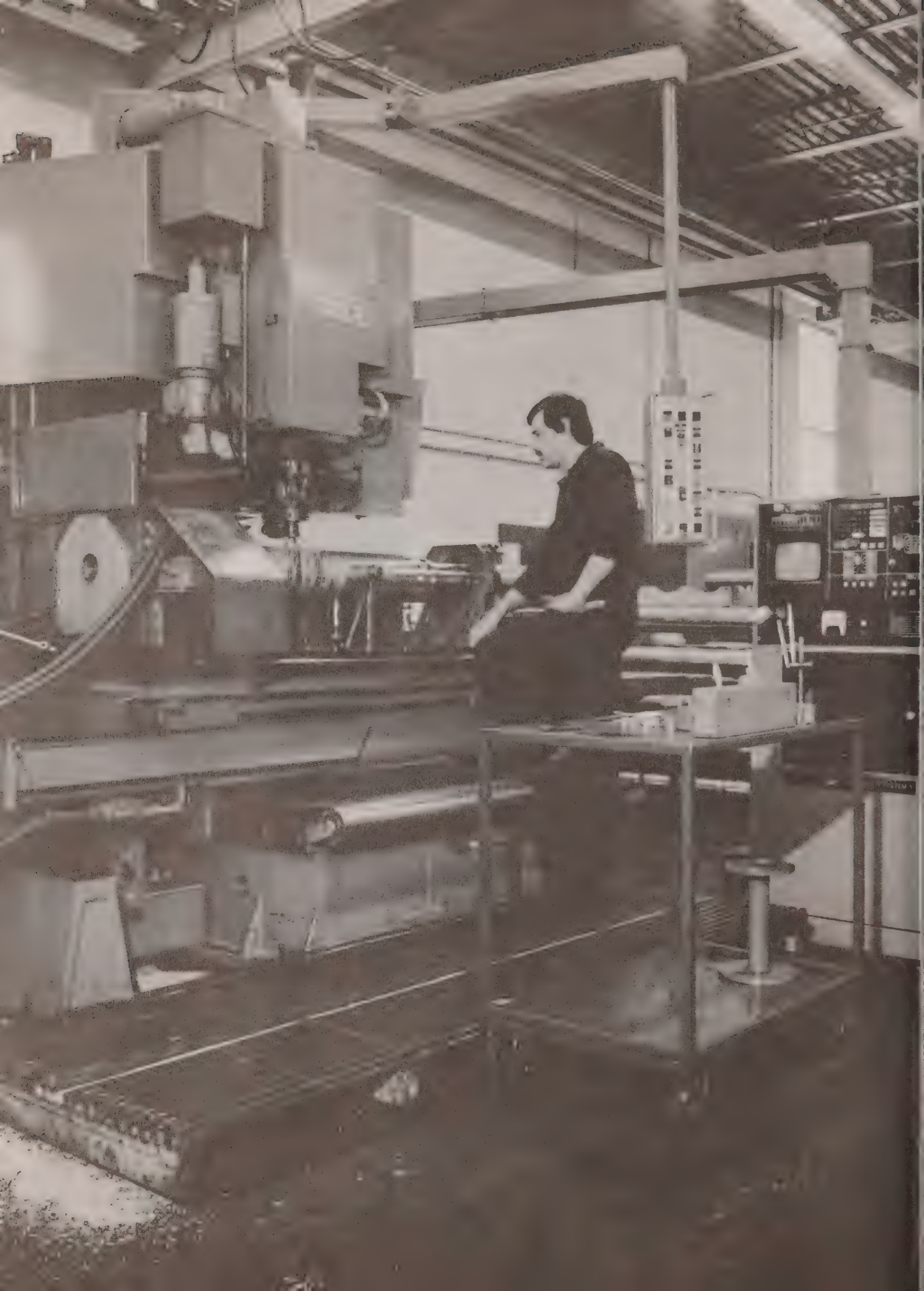
Since this year is the first year that several wineries have participated in the energy management survey it will not be possible to give a synopsis of their performance until a later date. However, it is a clear indication of these companies' concern for productivity in their operations that they submitted their results.

Table I **Food and Beverage Industry**
1988 Sector Results

	Number in Survey	1988 Imp. %	Total Imp. %	Base Year	Energy Cost (\$,000)	Total Savings (\$,000)
Bakeries	4	-0.9	17.0	1979	7,759	1,589
Biscuit Manufacturers	6	-1.7	13.7	1979	6,198	985
Breweries	6	1.7	9.2	1976	48,521	4,946
Confectionery	10	8.0	33.2	1981	8,035	3,993
Distilleries	8	-3.1	22.9	1977	21,667	6,465
Fisheries	3	3.1	29.6	1978	9,180	3,863
Food Processors	11	-0.6	22.5	1976	36,210	10,496
Grocery Products	15	1.3	28.3	1978	17,839	7,038
Meat Packers	8	0.7	42.6	1978	24,211	17,997
Poultry and Egg Processors	14	0.8	10.5	1982	7,894	930
Soft Drink Producers	48	-1.5	26.6	1980	12,657	4,596
Starch Manufacturers	4	1.8	34.2	1976	32,853	17,076
Sugar Refineries	5	4.5	36.0	1975	18,994	10,692
Wineries	3	—	—	1988	127	—
Food and Beverage Task Force	145	2.8	28.7	1977	252,145	90,666

Table II **Food and Beverage Industry**
Energy Consumption Statistics

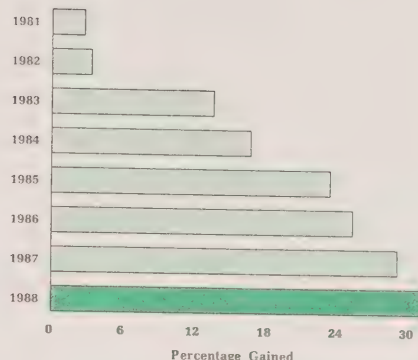
Energy Type	Units	1987 Consumption	Energy Distribution		
		TJ(10 ¹²)	1988	1987	1979
Electricity	2,295,769 MWh	8,265	21.9	20.7	16.9
Natural Gas	679,825,499 m ³	25,290	66.9	68.3	40.8
Fuel Oil	81,571,994 L	3,239	8.6	9.3	26.7
Propane	12,029,568 L	319	0.8	0.5	—
Diesel & Gasoline	20,293,000 L	578	1.5	0.9	15.0
Steam	n/a	110	0.3	0.3	0.6
Others	n/a	3	—	—	—
Total		37,804			
1985 Base Year Equivalent Energy:		40,724	Terajoules		
Efficiency Increase to	1985 =	21.53%			
	1986 =	1.24%			
	1987 =	3.15%			
	1988 =	2.78%			
Total Increase	=	28.70%			



General Manufacturing

Energy Conservation Task Force

Bent K. Larsen
Chairman



This report is based on a survey of members of The Canadian Manufacturers' Association (CMA). Companies have again been assigned to one of four main categories according to their general manufacturing technologies and energy intensities. Since most of the 50 participating companies have responded to the survey for several years, trend analysis is enhanced with the consistent grouping.

General Performance and Business Conditions

Consolidated energy efficiency improved 3.0% in 1988, boosting the total gain to 8.7% over the new 1985 base year and 32.1% above the aggregated 1980 reference year.

Based on an estimated total cost of \$130.6 million for fuel and electricity, the reporting companies saved \$4.0 million in 1988 or \$61.8 million since the base year. In 1988, the \$6.55 per gigajoule average

energy price is somewhat lower than in 1987 because this year's mix of responding companies reported using more "waste" fuels and slightly less electricity.

The 1988 performance gains appear to be the result of diversified energy conservation efforts, whereas some of the more spectacular gains recorded in recent years were attributed to exceptional business related factors. To date, the highest gain ever registered in this group occurred in 1983 (see Figure 1) when a 10% improvement resulted from concerted efforts to improve post-recession productivity. Another extraordinary efficiency surge (6.7%) occurred in 1985 when the industry's GDP rose 4.6% and capacity utilization was driven up 3%. Compared to these two outstanding years, 1988's increase of 3% reflects a more normal situation when capacity utilization (87.9%) was steady, spending on new capital machinery and equipment remained healthy and increases in energy prices were modest.

There was a broad focus on energy conservation, judging from the variety of responses on the survey questionnaires. This is a change from 1986 and 1987 when deregulated natural gas contracts and energy pricing received the most attention.

In 1988, energy conservation activities in this mixed group were equally divided into process and building improvements. At point of use, electricity and combustion systems were given equal attention. Expressions of interest in the use of computerized energy monitoring systems is beginning to be seen more frequently in the surveys. Energy managers in this sector, however, are generally concentrating on the basics.

In the process improvement category, apart from equipment upgrading, some companies appear to have discovered cost improvements from switching steam power to compressed air. This change usually means greater consumption of electricity but less overall waste and less

system idling. Some companies are looking seriously at the energy content of their products and report design changes to lower utility consumption. Using waste heat to dry raw materials and preheat water is a much more common practice.

Building improvements most often mentioned were added insulation to walls and roofs, upgraded windows, and reduction of general ventilation rates. Heating systems are a constant problem with different companies trying various solutions. For example, while one company mentioned cutting back on its radiant floor heating system, another said it had switched from steam heating to a natural gas radiant pipe heating system while yet another was investigating a special solar heating system.

Electrical improvements most often involved upgrading lighting systems. Demand control apparatus and additional capacitors to improve power factors drew limited comment. Scarce reference to high efficiency motors and process heating systems would suggest these measures are not yet a viable concern.

Combustion improvements involved the most innovative solutions. Companies appear to be opting for impulse or regenerative burners. Stack economizers are still being installed. One company is supplementing its natural gas fuel use with waste hydrogen, while another is burning its waste oil. Upgrading boiler controls appears to be an ongoing activity. Recovering baghouse air with a secondary filter will eliminate the need for a steam boiler in one site.

The various actions described above reflect some important realities about energy conservation in the general manufacturing sector. They demonstrate that basic, practical changes in the plant can still yield a solid 3% efficiency gain, but

very vigorous activity is required to push performance to the 5% or 6% level, as experienced in 1985. Perhaps this added incentive will come from the provincial electrical utilities' new demand side management (DSM) programs now in the development stages. Utilities have discovered what end-users learned back in the middle 1970's – conservation is the lowest-cost source of new capacity. Additionally, manufacturers around the world are discovering that energy management also plays a very significant role in reducing industrial pollution.

Group Trends

Rubber Products

The \$2 billion Canadian rubber industry, dominated by seven large tire manufacturing plants, is still experiencing the impact of major rationalizations in addition to modest initiatives to modernize remaining facilities.

Energy use per unit of production for this group improved 5% in 1988 which raises the total gain since 1981 to 34%. The solid 1988 gain, higher than the normal 3% improvement, is largely due to the shutdown of two large old plants – one a 50-year-old operation in Etobicoke, Ontario and the other in Hamilton. One new plant was built in Napanee, Ontario, to help service future markets.

Other sites report the type of modest improvements, e.g., upgraded boiler controls, electrical systems, etc., that imply a strategy of investing only in projects with quick returns. Tire companies are tied closely to the fortunes of the automobile manufacturing industry which, by mid-1989, experienced a drop in sales over 1988. Hence, the most recent efficiency gain may not be maintained unless there is renewed concern for productivity improvement.

The electricity share of total consumption is nearly 35% in the surveyed companies. Much of this is used for extensive materials handling systems. Because this consumption amounts to 48% of total energy budgets, companies have put a lot of effort into minimizing electrical expenses, especially demand charges. Electrical consumption has slowly risen by about 2% per year during the past 5 years of monitoring.

The balance between the mix of fuels, now 29% natural gas and 35% heavy oil may change slightly in the next few years as more plants are affected by overcapacity and shutdowns. It is expected this will occur mainly in regions now serviced by natural gas.

Specialty Chemicals and High Intensity Products

The six companies in this group make a variety of energy-intensive products including sodium chlorate, fibreglass insulation, and specialty chemicals. With this product diversity and the major energy conservation changes made in 1988, consolidated results are often difficult to generalize.

For example, Canadian Occidental Petroleum Ltd. changed its electrolytic process and boosted the group's base results from 4.6% to a whopping 24% gain for 1988. This single change was so dramatic that it raised the whole general manufacturing group performance by nearly 1%. As well, Occidental is now burning by-product hydrogen as a fuel. With its huge electrical load, control of the power factor in the 99% range is a necessity.

In contrast to this example, other companies in this group must resort to plant equipment upgrading and careful control of work practices to save energy. One firm mentioned its conservation program now includes

avoiding indiscriminate use of lighting and the continuous heating of plant hot water.

Foundries, Forging, and Heavy Metal Operations

The 23 companies reporting in this highly energy-intensive category had mixed efficiency gains that resulted in a group improvement of slightly over 1% for the year. Consolidated energy intensity gains stand at 6.2% since 1985 and 12.7% since the old 1981 base year. This group's energy shares amount to: 35% electricity, 48% natural gas, 12% coal and "waste" fuels, and 5% light fuel oil for interruptible gas contract purposes. The increased amount of electricity consumption shows that induction melting has become a widespread practice in this sector.

Energy management in this group apparently is given a mixed priority, according to the survey responses. Even when very similar operations in the same locality are compared, rankings vary from "low and the same for the next two years" to "high and increasing". Yet energy costs usually amount to about 7% of shipment values in foundries, nearly 10% for smelting and refining, compared with 4% for all manufacturing industries. On a value added basis, energy costs amount to 13% in the foundry sector, 24% for smelting and refining and 9% for all industries.

Light Manufacturing

Eighteen companies reported an aggregate improvement of 4% in 1988. This raises the aggregate improvement in energy intensity to 9.7% since the new 1985 reference year. In this group, electricity provides 25% of the power and natural gas 70%. Most of the natural gas is used for building heating.

Typical plant energy-intensities in this group are: metal stamping operations, 6440 kW/m² of floor space; office equipment and furniture manufacturing, 795 kW/m²; scientific and photographic equipment plants, 830 kW/m²; aluminum extruders, 1080 kW/m²; and machine shop type operations, 1150 kW/m².

The light durable-goods manufacturing sector is facing extremely tough competition because of lower-cost imports. Other factors, such as multinationals' "product mandating" and Canada's relatively higher domestic labour costs and small or diffuse markets, are placing intense pressures on productivity.

Many old plants have already been shut down because they were no longer viable. Some companies have merged with others or have been taken over to improve efficiencies through expansion. Aggressive companies like Bombardier Inc. have invested heavily in product development and expanded into world markets. Not surprisingly, energy efficiency gains being reported by the companies in this group generally reflect these changing circumstances.

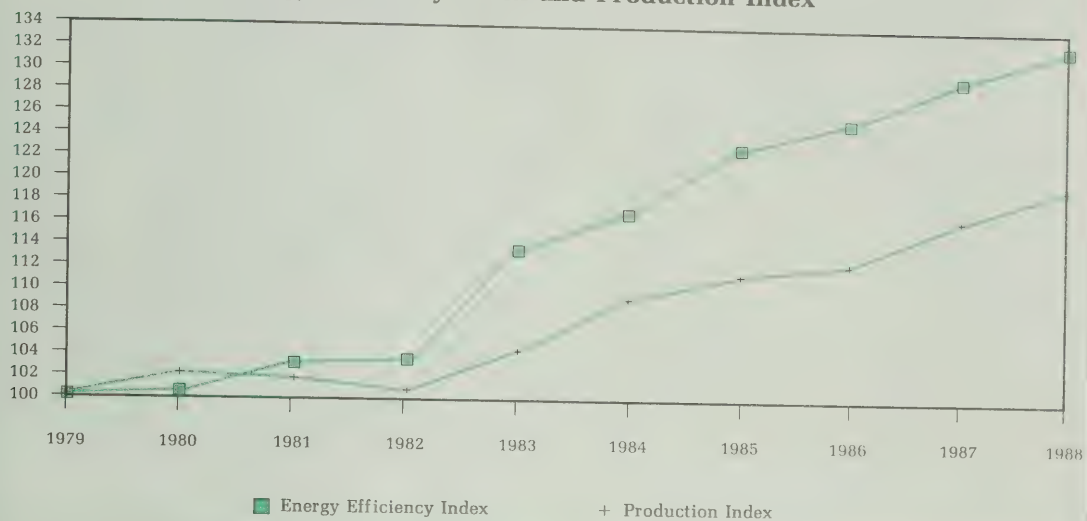
Table I

**General Manufacturing Industry
Energy Use**

<u>Type</u>	<u>Units</u>	<u>Gigajoules (10⁹)</u>	<u>Percent Distribution</u>		
			<u>1988</u>	<u>1987</u>	<u>1985</u>
Natural Gas	268,061,194 m ³	9,971,877	50.1	51.7	60.2
Electricity	1,660,707 MWh	6,698,547	33.6	37.6	28.1
Liquid Petroleum Products:					
#2 Oil	6,219,253 L	242,551	1.2	0.2	1.2
#6 Oil	31,540,543 L	1,277,393	6.4	8.8	9.6
Diesel	2,594,264 L	103,511	0.5	0.6	0.4
Gasoline	1,814,657 L	65,691	0.3	0.5	0.1
Other Fuels:					
Propane	8,469,509 L	225,289	1.3	0.3	0.3
Steam	n/a	36,433	0.2	0.2	—
Others	n/a	1,288,950	6.4	0.1	0.1
Totals		19,910,242			
1985 Base Year Equivalent Consumption:		21,813,333 Gigajoules			
Energy Efficiency Gain between 1981 and 1985:		23.4%			
	1986:	1.9%			
	1987:	3.8%			
	1988:	3.0%			
Total Energy Performance Improvement:		32.1%			

Figure I

General Manufacturing Energy Efficiency Index and Production Index



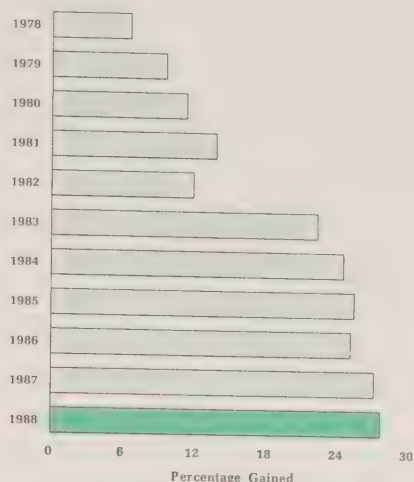
Source: Statistics Canada 31-003, CIPEC reports.



Industrial Minerals Industry

Energy Conservation Task Force

John A. Clarke
Chairman



Task Force Description

The Industrial Minerals group consists of 9 different sectors that mine, process and/or manufacture a variety of non-metallic products for subsequent use in the construction and steel industries. The combined GDP of these sectors amounted to \$11 billion in 1988.

This survey covers an estimated 92% of the total energy consumption in the industrial minerals industry. About three-quarters of the total energy consumption in the highly energy-intensive ceramics industry (abrasives, brick and tile, glass, and refractory) is included in this survey. Porcelain and pottery manufacturing companies normally do not participate. All of the cement manufacturing, half the lime producers and about one-quarter of the concrete products and miscellaneous minerals processing companies in Canada are included.

General Performance

Energy efficiency gained 0.6% in 1988 to raise total improvement to 2.4% above the new 1985 reference year and 27.8% over levels established in 1975 when monitoring began.

Based on a calculated total cost of \$433.5 million for fuel and electric-

ity, reporting companies saved \$2.8 million in 1988 for a total of \$166.6 million since the base year¹. Table 1 shows group performances and energy costs. Table 2 displays consumption of each type of energy.

Very little of the total efficiency improvement has come from new or revised processes in this industry. Most of the manufacturing processes are very mature and not subject to major changes. There is improvement potential, however, as noted in the individual sector reports. Maintaining the effectiveness of equipment insulation, heat recovery, closer control of combustion systems and electrical demand are common opportunities for energy conservation throughout the industry.

As might be expected, those sectors with the highest energy intensities, e.g. glass, cement, refractories and abrasives, still regard energy conservation as a "high priority" activity. Most surveyed companies in the medium and low intensity sectors say the status of energy management is currently holding firm but

not necessarily increasing. Energy-related improvements must compete with other business opportunities for capital where a two-year payback is still desired.

The pattern of fuel substitutions throughout the industry has been mixed because of practical restrictions on the ability to burn different fuels. As well, minor variations occur from year to year because of slight changes in the reporting population. Energy distribution is shown in Table 2.

Energy substitutions have had a noticeable impact on the allocation of energy budgets. Since 1979, while the group's proportion of electricity use rose only 2%, its share of total cost has risen 15%. At current prices, this translates into about \$54 million being redirected to electricity. This situation has become a major concern to companies in the electricity-intensive sectors, particularly in the abrasives and refractory manufacturing operations, where electrical costs are regularly compared with those of foreign competitors.

While there has been only a 6% share reduction in natural gas use since 1979, the large drop in deregulated prices has resulted in a savings of \$37 million among participating companies. Nevertheless, natural

¹ This total cost savings figure should not be compared to previous year's since variations are introduced when companies fail to submit their results for consolidation.

gas is still the dominant fuel used in the industrial minerals industry.

The decline in fuel oil consumption proceeded faster than falling prices, driven by government substitution incentive programs and concerns about availability. Between 1979 and 1988, the fuel oil share dropped from 27% to 8% of total energy while the proportion of total cost declined from 28% to 11%. In so doing, some \$41 million was trimmed from this category of energy budgets. The very slow rate of decline in the fuel oil share now appears to signal that a new economic balance point has been reached.

Coal has had a major impact on reducing the consumption of fuel oil as well as a minor effect on natural gas. During the 1979 to 1988 period, consumption of coal has more than doubled from 16% to 36%, but its percentage of total energy cost has only risen from 6.7% to 10.8% in the surveyed companies. As a result, an additional \$13 million has been shifted to coal.

It is difficult to generalize on the impact of capital spending on energy efficiency because of the vast difference in capital and energy intensities, rate of spending, etc., in various sectors. However, the impact of annual spending on new machinery, growing from \$193 million in 1985 to \$359 million in 1988, has helped raise production capacities far more than energy efficiencies. Moreover, early indications of slower future capital spending and the prospect of lower capacity utilization rates does not appear to support continued energy efficiency improvement.

Sector Reports

Abrasives

This industry consists of 5 companies that make energy-intensive raw aluminum oxide and/or silicon carbide by electro-fusion technologies.

Silicon carbide is made by fusing coke and sand together in large donut-shaped electric resistance "furnaces". The energy intensity of silicon carbide production varies between 12,000 and 14,000 megajoules per tonne of product, depending on

the size and configuration of the furnace. About 88% of the total energy is supplied by electricity and 12% from natural gas which is used for exhaust gas cleanup. Heat is captured from the raw coke but this does not enter into the efficiency calculations.

Raw aluminum oxide is made by fusing chemically purified alumina with fluxing agents and other admixtures in conventional electric arc furnaces. The electrical intensity of this process is in the 10,000 megajoules per tonne of product range.

Since no major energy substitutions have occurred, it is estimated that 97% of the total 10.4% efficiency gain since 1982 has come from more efficient control of electricity. This has resulted in a total cost saving of about \$5.8 million in the surveyed companies.

Energy management actions common now are the careful control of production scheduling and product quality control to avoid excessive energy input, poor electrical conductance and distribution system losses, and excessive losses during the initial stages of arc furnace melting.

Future energy savings might come from application of plasma extended arc reactor (PEAR) technology. Pilot plant studies are now being done outside Canada although Ontario and Hydro-Quebec have conducted applied plasma arc research for many years.

Asbestos

After several years of reduced markets and capacity rationalization, 1988 saw a slight increase in asbestos production due to development of new markets in Asia and Europe. Production amounted to 705,000 tonnes, up 40,000 tonnes from 1987.

As a result, energy use per unit of production decreased 3.8% in 1988, bringing the total efficiency gain to 10% over the new 1985 base year. The overall gain since monitoring began in 1979 is now 15.8%

Some \$46.1 million is spent on fuel and electricity in this sector, where four open-pit mines are lo-

cated in Quebec and one company, situated in British Columbia, is producing from both an open-pit and an underground operation. Consequently, there is a wide variation in energy costs and energy intensities. At an average 6570 megajoules/tonne of processed raw fibre, however, energy conservation is seen as one of the important means of adding to marginal operating profits. Energy costs still amount to about 20% of the total manufacturing costs in this sector.

Housekeeping and maintenance and minor heat recovery projects are the mainstay of energy conservation programs in this sector.

The British Columbia company is totally dependent on distilled fuel oil for its energy needs including generation of electricity for the mill and town site. The Quebec companies' energy split has been a constant 35% for electricity, 42% from residual fuel oil and 23% for vehicle operation for the past decade.

Cement Manufacturing

The rate of improvement faltered at 0.6% during 1988 because most cement plants were operating at maximum capacity. In previous years, average increases of two to three times this rate were achieved as capacity utilization levels kept rising. Energy consumption per unit of production has improved a total of 22.6% compared with the 1974 base year level.

A total of eighteen gray clinker cement plants, producing 10,715 equivalent tonnes² by the wet-process (21.9% of the total) and dry-process (78.1%), are represented in this survey. Future capacity and operating efficiency will improve in 1989 when a new 5000 tonnes per day state-of-the-art enlargement is completed in a plant near Toronto, as well as expansions in a Montreal area plant.

² An equivalent tonne is a weighted measure of production that accounts for the different energy intensities required to make clinker and cement. In most "balanced" plants, 85% of the energy is used to make clinker and 15% used to make cement. In this survey, the weighted average is proportioned 92% for clinker production and 8% for cement production.

Significant improvements in some of the wet-process plants were achieved during 1988, with the result that average energy intensity fell to 5,777 megajoules per equivalent tonne from 6,093 MJ/E.T. in 1987. Wet-process plants consumed 6,501 MJ/E.T. in 1974 when monitoring began.

By comparison, the inherently more efficient dry-process plants (with no preheater) saw a loss of efficiency when average energy intensity rose from 4,472 MJ/E.T. in 1987 to 4,620 MJ/E.T. in 1988. Plants with preheaters managed to increase efficiency 0.6% to 4,598 MJ/E.T. during the year.

Total cost of fuel and electricity amounted to \$181 million which usually represents about 23% of total manufacturing costs. Energy efficiency improvements alone, since 1974, are now saving the cement manufacturers some \$94 million each year, at current energy prices.

Some very dramatic shifts in energy sources (ignoring efficiency gains and process changes) have occurred since monitoring began in 1974. For example, the net electrical intensity has risen from 138 kWh/cement tonne in 1974 to 147 kWh/cement tonne in 1988.

St. Lawrence Cement Inc. in Mississauga has been conducting refuse burning studies for the past 4 years to gather the necessary data for environmental approvals and large-scale project development. Cement kilns are ideally suited for disposal of most municipal and some hazardous wastes. In fact, 100% of Canada's combustible wastes could be safely disposed of in the existing domestic cement kilns and thereby reduce conventional fuel consumption by 47%.

Clay Brick, Tile, and Clay Products

Even though the basic brick making process is 5000 years old, technological advances are still being made in his industry.

In the surveyed companies, while mixed performances resulted in a 1.4% increase in energy consumption per unit of production during 1988, overall performance is still

27.9% better than it was in 1978 when monitoring began. Where efficiencies slipped, it was generally in those companies beginning to experience lower capacity utilization rates caused by slowing construction markets. In this sector, energy costs often amount to 25% of total manufacturing expense. Careful scheduling of production is therefore important to maintain production efficiencies and inventories at their best levels.

The energy intensity of clay brick manufacturers now averages 3585 megajoules/tonne (1.8 tonnes/1000 equivalent units) while the energy intensity of short run clay tile producers is often three times this amount.

Several companies report continuing heat recovery improvements and gains from computerizing burner controls on their kilns. Some mentioned scheduling production on their most efficient equipment as a significant energy efficiency control technique. Electrical systems are still being improved by installation of additional capacitors and demand peak controllers.

Fuel and electricity would have cost \$6.5 million more during 1988 if there had been no efficiency gains since 1978. This saving is based on the total energy cost of about \$15 million and overall efficiency gains achieved to date. Three-quarters of this cost saving has been achieved by more efficient combustion of natural gas and/or heat recovery while one-quarter of the savings have come from improvement in the electrical power systems.

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Natural gas has completely replaced the use of fuel oil in this sector. Now, the cost share of natural

gas has risen to 79% of the total energy expense, while electricity, using only 7% of the total consumption, accounts for 21% of the overall cost. Most companies in this sector are benefitting from deregulated natural gas contracts.

Concrete Products

The concrete products sector is a diverse manufacturing group that make concrete blocks, sewer casings, precast slabs, and a host of miscellaneous products for the construction industry. It is a moderately energy-intensive operation requiring about one-tenth of the energy used to make cement. Concrete blocks, for example, generally require 350 to 500 megajoules per tonne of product, depending on the type of curing system used.

While overall energy utilization is 15.9% better than it was in 1979, there was no noticeable gain recorded in 1988. The mix of energy use in this group reflects the large yard materials handling activities, e.g. 5% for plant electrical use compared with 23% for diesel vehicles. Over two-thirds of the total energy mix comes from natural gas used to generate steam for the curing autoclaves.

In recent years, energy management attention has concentrated on lowering natural gas costs, primarily by negotiating the best prices available.

Glass

The 5 companies surveyed in this sector operate 19 large continuous glass making plants which produce about 90% of the glass containers, flat glass and fibre insulation used in Canada.

Tough competition and poor markets, made worse by provincial government Container Act policies, have caused some rationalization of container product furnace operations during the year. Glass melting furnaces and processing equipment have a very limited turndown range and must completely shutdown to avoid gross inefficiencies.

Fuel and electricity cost this group \$99.5 million in 1988. Energy

utilization gained 2.1% in 1988 which raised the total to 35.9% over the original 1974 base year reference values. In so doing, the participating companies are saving \$34 million per year due to various operating improvements.

Even though the cost and energy consumption mix is moderately different among reporting companies because of their various end products, the net effect of the energy substitutions has resulted in significant savings. For example, the electrical consumption share rose from 9.4% in 1979 to 18.4% in 1988 while its share of total costs went up from 27% to 43%.

Over the same period the natural gas cost share shrank 27 points (from 78% to 51%), while consumption declined only 7 points (from 84% to 77%). Clearly, companies' bottom line benefitted from deregulation in natural gas markets. A smaller reduction (8% to 6%) in fuel oil consumption also helped lower annual energy costs.

Most glass making applied R&D efforts are being concentrated on fusing the raw materials directly inside special burners. This technique provides quicker melting, reduced furnace residence time, and operation of low-excess air combustion systems. Tests also continue on use of recovered waste heat for preheating cullet feed (up to 1,100°F) to reduce the need for electric boosters.

Most of this sector's energy savings have been achieved by modifications to the glass melting furnaces, i.e. optimum cycling of regenerative combustion systems, repositioned burners, more effective insulation systems, etc. Significant savings have also been achieved from better heat control in the different annealing oven zones.

Glass plants are now installing modern real-time data acquisition systems to provide the heuristic data for more effective control systems as well as daily accounting of operating efficiencies and utility costs.

Because glass making is a very energy-intensive operation requiring about 4.7 gigajoules per tonne for the melting operation alone,

energy management remains a routine activity throughout this sector.

Lime

The companies reporting in this group make various grades of lime and cement, and process a number of dolomite products for fluxing, refractory and chemical use. Lime is made by calcifying quarried limestone at 265°F in rotary kilns. Lime manufacturing now requires an energy rate of about 6300 megajoules/tonne, which often amounts to 40% of total manufacturing cost.

Energy efficiency improvement slowed to half the usual 1.2% per year gain because most of the benefits from kiln upgrading projects and gains from high capacity utilizations have already been realized.

While some lime kilns are fired with coal, natural gas is the preferred fuel when high product purities are essential. Among the surveyed companies, coal consumption has represented about 12% of the total mix for the past 6 years. Use of fuel oil has been reduced from 32% to almost nil since 1979, while the natural gas share has risen from 52% to 80%. Lime making and processing is a low hydro intensive operation requiring less than 6% of the total energy consumption mix. Even so, the proportion of electrical costs has risen from 7.5% in 1979 to 12.5% in 1988.

Miscellaneous Minerals

This diverse group of companies produces a variety of products such as silica sand and nepheline for glass making, raw crushed limestone and gypsum products, roofing granules, and sodium sulphate. Many of these products require extensive crushing and pulverizing, milling, refinement, drying and grading operations run on intermittent time schedules.

Group performance slipped 1.9% in 1988, largely because capacity utilization started to decline from previous high levels in many of the surveyed companies. This leaves the overall improvement at 11.8% over the 1977 reference values.

For the current reporting group, 38% of total energy is provided by electricity, 47% by natural gas, 9% by vehicle fuels, and 6% by coal. Use of electricity has steadily grown during recent years. Additional use of natural gas has offset the 20% drop in consumption of fuel oil since 1979.

Electrical systems continue to receive the most attention with general overhauls, installation of peak demand controllers, and replacement of old process equipment. Some companies are taking advantage of extended downtimes to make these extensive improvements. Replacement of rotary dryers with more efficient fluidized bed dryers is also in progress.

Refractories

Meaningful performance information is difficult to aggregate because there has been a significant change in product mix in this small sector. What's more, many of the companies are reluctant to divulge too much data because of tough domestic and growing international competition.

However, companies are quick to note their "high" priority concerns for energy conservation. Most companies in this group have had up-to-date technical audits conducted and have also investigated the latest electrotechnologies.

Average fired product energy intensities are in the 6500 megajoule/tonne range and energy costs usually represent about 40% of manufacturing expenses. Approximately 85% of this energy is supplied by fossil fuels, which can be either natural gas or fuel oil, depending on the location of the company. Sufficient reporting has been done over the years to indicate that process efficiencies have been improved by 10.5% since 1975. Based on the reporting population's energy consumption, fuel and electricity cost some \$4.6 million.

Table I

Industrial Minerals Industry Energy Consumption and Cost

Sector	Consumption Terajoules	Eff. % Gain	Total Eff. % Gain	1990 Target	Base Year	1988 Est. Cost (\$,000)	1988 Savings (\$,000)
Abrasives	3,202	-0.86	10.4	20	1982	36,359	5,843
Asbestos	5,154	3.81	15.8	10	1979	46,169	9,406
Cement	51,622	0.64	22.5	40	1974	181,118	94,207
Clay Brick	3,584	-1.43	27.9	40	1978	15,000	6,540
Concrete Products	637	-0.24	15.9	20	1979	4,017	1,162
Glass	18,569	2.15	35.9	50	1974	99,586	33,888
Lime	4,714	0.60	17.8	25	1979	25,608	8,602
Miscellaneous	2,875	-1.90	11.8	15	1977	21,026	5,246
Refractories	961	0.04	10.4	15	1975	4,605	1,754
Totals	91,318	0.65	27.8	35	1975	433,488	166,648

Table II

Industrial Minerals Industry Energy Use and Efficiency

Type	Units	Petajoules (10 ¹⁵)	Distribution %		
			1988	1987	1979
Natural Gas	956,886 m ³	35.596	39.0	42.7	44.9
Electricity	4,216,848 MWh	15.180	16.6	15.5	13.9
Liquid Petroleum Products:					
#2 Fuel Oil	14,474 kL	0.565	0.6	0.6	2.7
#6 Fuel Oil	85,054 kL	3.445	3.8	4.0	14.5
Diesel & Gas	60,826 kL	2.412	2.7	2.0	7.4
Coal	10,300,000 T	33.063	36.2	34.0	15.8
Other Fuels:					
Propane,LPG	9,642 kL	0.257	0.3	0.2	0.2
Steam	—	0.800	0.8	1.0	0.6
Total		91.318			
	1988				
	1987	91.262			
	1986	82.632			
	1985	80.081			
	1984	79.217			
	1983	74.291			
	1982	84.229			
	1981	100.403			
	1980	98.615			

1985 Base Year Equivalent Consumption = 93,533 Petajoules

Efficiency Improvement to 1985 = 25.4%
 in 1986 = -0.3%
 in 1987 = 2.0%
 in 1988 = 0.65%

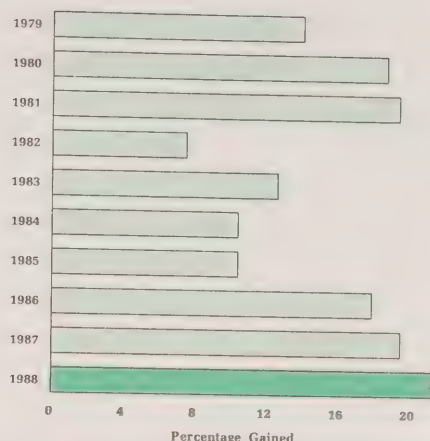
Total Improvement = 27.7%



Machinery Industry

Energy Conservation Task Force

Frank A. Hlohovsky
Chairman



Task Force Description

The energy consumption and trends contained in this report are based on the results of a survey conducted by the Machinery and Equipment Manufacturers' Association of Canada (MEMAC). MEMAC member firms manufacture a wide spectrum of plant, mill and field equipment used by all resource and manufacturing industries, ie., machinery and equipment which is used in public utilities, in steel mills, in automobile factories and in the mining and forestry industries; the pumps, valves, compressors and drills used by the petroleum and construction industries and products such as conveyors, cranes, packaging and printing machinery, which are utilized by a number of industries.

The survey covered approximately 100 firms, including several non-members. The response rate was 31%. The majority of firms are located in Ontario and Quebec.

General Performance and Progress

The participating firms reported an aggregated energy intensity improvement of 1.7% during 1988. This result means that the sector has improved 11.1% since the new 1985 base year level, and 21.5% since the machinery industry joined the program (see Table 1). The industry has already reached its goal of 15% by 1990.

The factors that contributed to this success are many and are impossible to quantify. The probability of the Canada/U.S. Free Trade Agreement, for example, has prompted firms to rationalize production, and energy utilization may have shifted elsewhere rather than being attributable to improved energy efficiency. Furthermore, the overall economic improvement in this sector of the industry since the mid-1980's has allowed firms to invest in new plant, equipment and processes which have increased productivity and improved energy efficiency. In addition, firms are sub-contracting work

to specialized shops which may distort the measurement of energy utilization. New materials and processing techniques also contribute to improved energy efficiencies. The one certain factor is that each firm, in its own way, addresses energy efficiency as it develops its strategic plan.

Task Force Activities

No new major MEMAC initiatives are planned for the immediate future but the industry will continue to work with both federal and provincial authorities to ensure that energy management programs continue to have a high profile. We intend to work with other agencies which have been successful in promoting energy conservation. For example, the auditing programs of the Quebec and Ontario governments will continue to be recommended to members. We will also take advantage of the highly effective and visible advertising programs of Ontario Hydro. These programs are well

received by members because they offer a practical way to improve the efficiency of energy utilization.

In conclusion, this sector has achieved its 1990 goal and will continue its efforts to reduce energy costs. It is recognized that improved operating efficiencies are essential if Canada is to maintain its level of productivity and competitiveness in the global economy. It is expected that the greatest potential for additional energy efficiencies will be through the use of new materials and innovative manufacturing techniques.

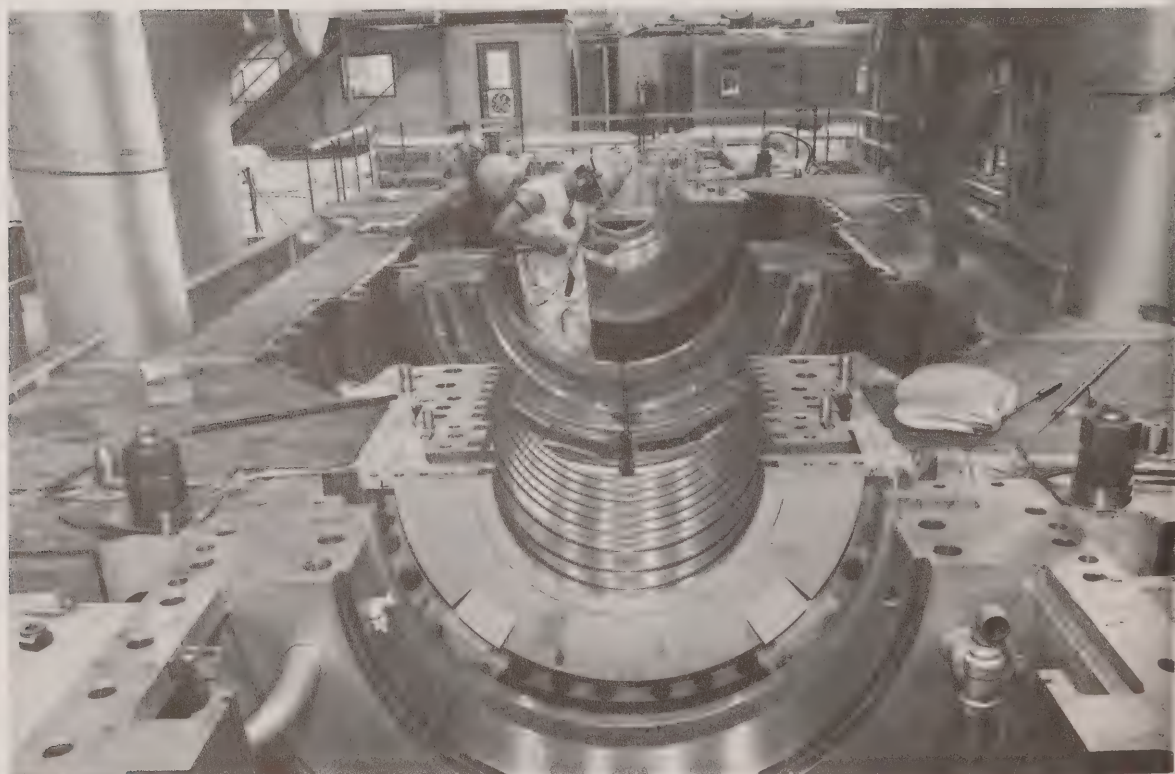


Photo - Ontario Hydro

Table I

Machinery Industry Energy Use and Efficiency

<u>Type</u>	<u>Units</u>	<u>Gigajoules</u>	<u>Distribution %</u>	
		<u>(10⁹)</u>	<u>1988</u>	<u>1985</u>
Natural Gas	9,128,522 m ³	339,581	52.6	36.7
Electricity	69,587,235 kWh	250,514	38.8	41.3
Liquid Petroleum Products:				
Distillate Oil	1,016,551 L	39,646	6.1	8.8
Crude Oil	40,000 L	1,608	0.2	10.5
Diesel	10,362 L	413	0.1	0.1
Gasoline	223,185 L	8,079	1.3	1.3
LPG	36,764 L	996	0.2	0.4
Other Fuels:				
Propane	179,453 L	5,049	0.8	1.0
Total	1988	645,886		
	1987	566,274		

1985 Base Year Equivalent Consumption = 726,531 Gigajoules

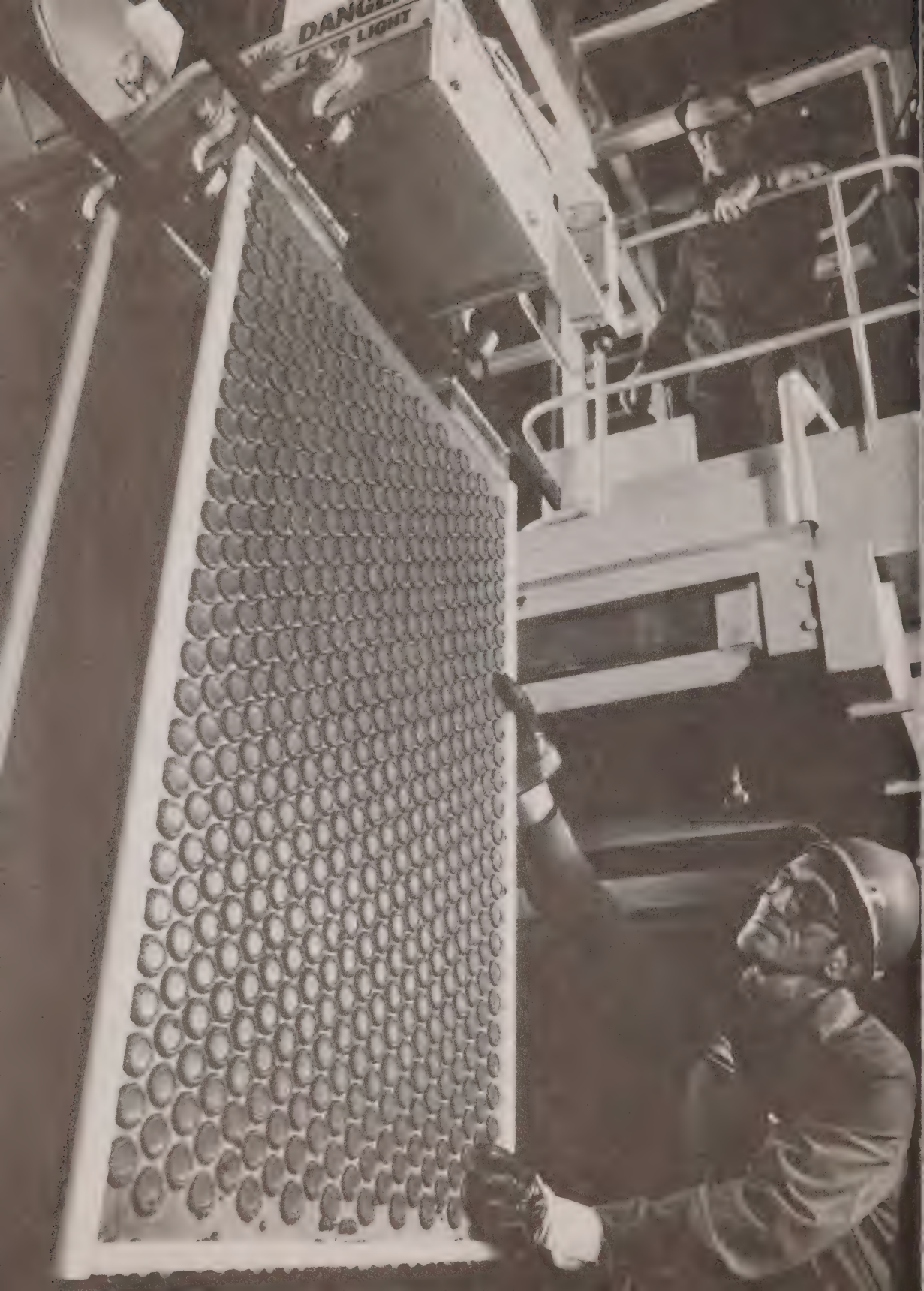
Efficiency Improvement 1975-1985 = 10.4%

in 1986 = 7.5%

in 1987 = 1.9%

in 1988 = 1.7%

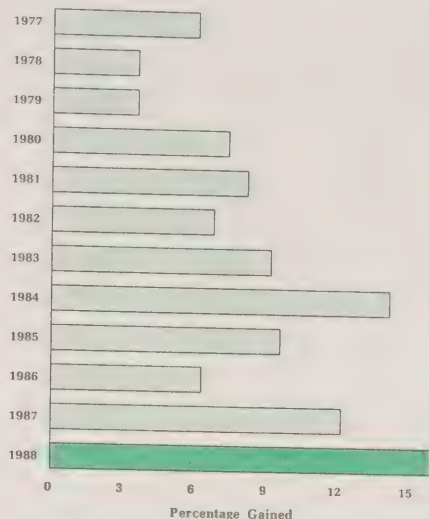
Total Improvement = 21.5%



Mining and Metallurgy Industry

Energy Conservation Task Force

Jean Gilles Girard
Chairman



Task Force Description

The Mining and Metallurgy Energy Conservation Task Force was organized in 1975 and is operated under the auspices of the Mining Association of Canada (MAC). Its membership includes the major Canadian producers of iron, copper, nickel, lead, zinc, gold, silver, aluminum, molybdenum, uranium, synthetic oil and fertilizers. A number of energy-intensive processes are used including milling, smelting, indurating and electrochemical refining.

A total of 13 major integrated companies participated in the 1988 survey. These companies operate a total of 26 mine sites in addition to the associated processing operations. Some 80-85% of the total Canadian mining industry output is represented.

The task force continues to focus on technology transfer activities by providing technical seminars and disseminate study literature to its members.

Performance

The participating companies had an aggregate 3.7% improvement in energy intensity over 1987, raising the total gain of 16% since 1973. The 1990 target of 15% has thus been surpassed two years earlier than fore-

cast. A new target will be established for 1995.

The value of the energy consumed was estimated to be \$905 million. However, the 1988 energy bill would have been \$35 million higher if the 3.7% improvement in energy efficiency had not occurred.

In the mining industry energy efficiencies are very sensitive to changes in output, as shown in Figure 1. This graph compares the annual growth rate of GDP and the improvement in energy intensity. Energy efficiency gains are usually a few percentage points below the annual GDP growth rate. However, during the 1981-1982 recession this relationship reversed because companies made extra efforts to maintain production efficiencies.

Energy Use Patterns

There was no discernable change in the distribution of energy shares between 1987 and 1988. The trends over the past decade are presented in Figure 2. During the period natural gas consumption has slowly replaced the use of petroleum products. This was brought about by the oil price shock of the 1970's and deregulation of the natural gas market in 1985 which reduced prices. Electricity's share of total costs has risen from 56% to 63%, despite the fact that its share of total consumption has fallen marginally in favour of coal.

The task force's energy distribution figures cover a variety of processes. A more detailed breakdown is provided as noted on table I¹.

¹ Acres Consulting Services Ltd., "Ontario Industrial Energy Demand Study", Ontario Ministry of Energy, 1980.

Table I

	Task Force 1988	Mining & Milling	Smelting & Refining
Electricity	34.5	36.7	16.9
Fuel Oil ₂	15.7	20.4	8.1
Natural Gas	40.5	37.8	47.5
Coal	8.6	2.0	27.4
Other ₃	0.7	3.1	0.1
	100.0	100.0	100.0

² Diesel, kerosene, light fuel oil and heavy fuel oil.

³ "Other" includes gasoline.

The huge potential for energy recovery from heating, ventilating and air conditioning (HVAC) equipment receives on-going study in the mining industry. Compared to other countries' mines of equal depth, Canadian underground mines are generally cooler and experience some heating load in the winter months. At a few locations glycol loop systems recover waste heat from exhaust ventilation air for use in the shaft house, an adjoining office or, in one case, in a greenhouse.

There are many sources of underground mine heat such as: heat from uninsulated compressed air lines or hot water lines, evaporation from hot rock walls, hot water from underground sources, adiabatic compression of the inlet air down deep shafts, heat liberated by blasting, and friction from moving air. All these sources of heat add to the ventilation and air conditioning loads.

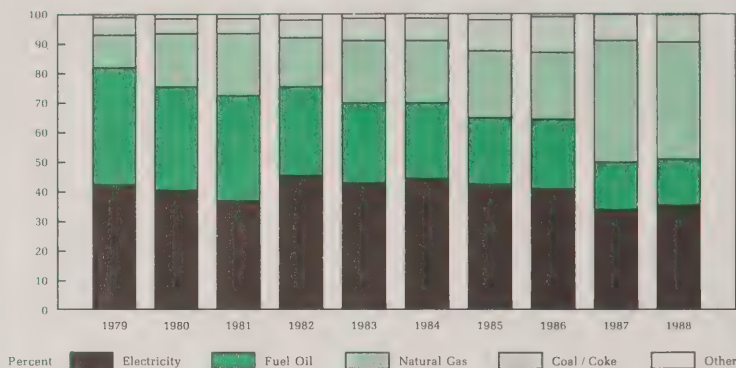
Underground power-operated equipment also transfers large quantities of heat into the mine atmosphere. Heat produced by diesel equipment equals about 90% of the energy content of the fuel consumed, or 35.9 MJ/L. Most mines have switched to electric drive vehicles or electric-hydraulic systems which release only one-third to one-half the heat given off by diesel powered equipment. At the same time ventilation demand is reduced.

One mine satisfies part of its cooling load by spraying water on rocks surrounding the intake shafts during the winter months to make ice. In summer, intake air is cooled by drawing it over this ice. This is the least expensive way of cooling a mine in the summer. Underground cooling plants are often used in deep mines close to the work area, but expensive electricity is consumed pumping cooling water to the surface.

There is a significant potential for on-site generation of electricity as there is a demand in the smelting and refining processes for both vast quantities of electricity and process heat. Processes where electricity is consumed include the mining and

Figure II

Mining and Metallurgy Industry Historical Energy Distribution



milling of ore; the smelting of base metals such as nickel, copper, and zinc using electric "submerged-arc" furnaces; and the electrolytic refining of these metals. Large quantities of heat are used in the roasting phases and reverberatory or flash type furnaces which burn fossil fuels.

Falconbridge Limited, located in Sudbury, Ontario, is currently participating in the joint Ontario Ministry of Energy/Ontario Hydro "Energy Monitoring Demonstration Program". The system being installed features approximately 127 meters measuring electricity, natural gas, hot water and compressed air use. The system consists of an industrial minicomputer at each of five locations. One computer receives summary data from the other four and provides overall system co-ordination as well as controlling peak and off-peak electricity use. It is expected that the system will help optimize the production processes and minimize specific energy intensities.

Future Outlook

1988 was a good year for producers of primary metal products. Production gains were widespread, with increases recorded in smelting and refining of gold, nickel, silver and aluminum. Exports of all refined minerals except copper increased. Gold mines increased production by 15% in 1988 following gains of 15% in 1987 and 25% in 1986. Three

major new mines started operations in December 1988. Iron ore mines recorded a 10% rise in output, reflecting increased shipments of about the same magnitude to both U.S. and Canadian steel mills. Higher output levels require longer production runs and provide the opportunity to fine-tune processes. Energy efficiency results, therefore, usually advance along with surges in activity.

The Canadian mining and metallurgy industry posted significantly higher profits in 1988 following the recovery of base metal prices. But none of the extra income will go toward increasing capital expenditures. Spending intentions for 1989 on construction, machinery and equipment indicate a decline of 6.4% in 1989, from \$2.54 Billion to \$2.38 Billion. Repair expenditures are expected to increase marginally from \$1.75 Billion to \$1.8 Billion.

Table II

Mining and Metallurgy Industry Energy Use

Type	Units	Terajoules	1988	1985	1980
Natural Gas	1,472,634 km ³	54,782	40.5	23.1	18.6
Electricity	12,962,778 MWh	46,666	34.5	41.2	39.6
Liquid Petroleum Products:					
Distillate Oil	138,744 kL	5,411	4.0	4.4	6.1
Residual Oil	172,671 kL	7,304	5.4	15.6	27.1
Diesel	203,409 kL	8,116	6.0	4.0	2.1
Gasoline	11,215 kL	406	0.3	0.3	0.3
Coal	151,713 tonnes	4,870	3.6	4.9	2.0
Coke	290,257 tonnes	6,763	5.0	5.0	2.5
Other Fuels:					
Propane, LPG	25,413 kL	676	0.5	2.1	1.2
Others (hot water, steam)	n/a	271	0.2	0.2	0.5
Totals	1988	135,265			

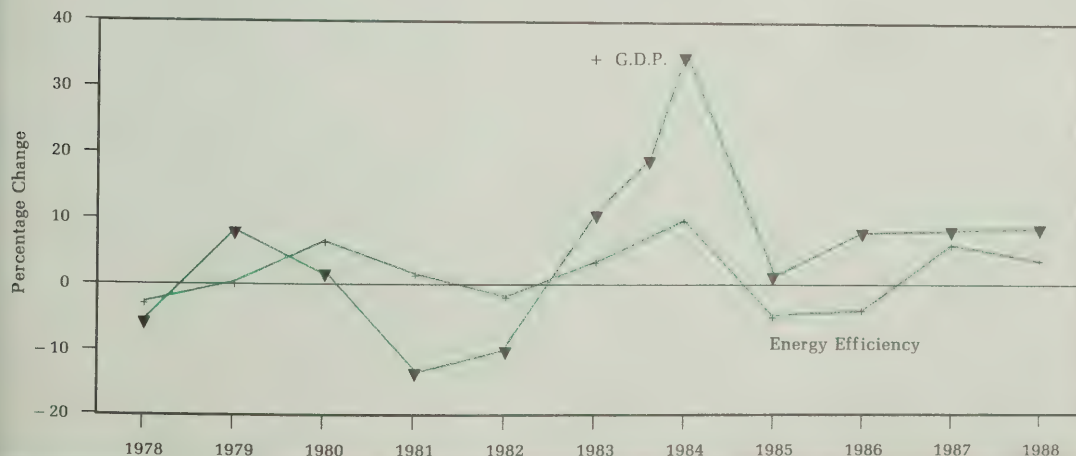
Table III

Mining and Metallurgy Industry Energy Efficiency Improvement

Current year (1988) total energy inputs	135,265 terajoules
Base year (1985) equivalent energy inputs	143,647 terajoules
Adjustments (1985-1988)	882 terajoules
Net Improvement = 6.4%	
Efficiency gain 1973 - 1985	9.6
1986	-3.3
1987	6.0
1988	3.7
Total gain 1973 - 1988	16.0%

Figure I

Mining and Metallurgy Industry Annual Rate of Growth



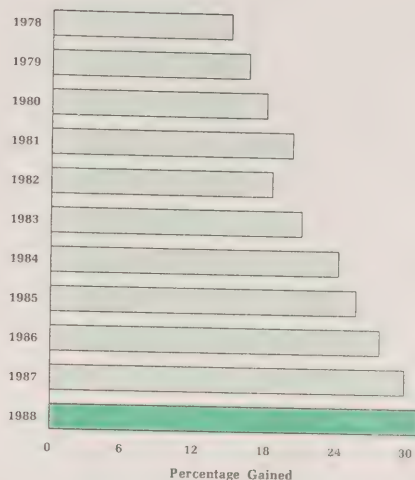
Source: StatsCan 15-001, CIPEC Reports.



Petroleum Refining Industry

Energy Conservation Task Force

Glen G. Myers
Chairman



The Petroleum Refining Industry Task Force established in April 1977 is continuing in the role of reporting on energy conservation progress in its sector. This report for 1988 is based on submissions from 10 companies which process in total about 90% of the crude oil upgraded and refined in Canada.

Major changes in the industry and the energy monitoring facilities in use have made it necessary to adopt a more recent base year to accurately quantify recent improvements in energy consumption. The year 1985 has been selected as the new reference. For consistency, the energy reduction since 1985 has been added to the 25.6% reduction achieved earlier during the period between the original base year (1972) and the new base year.

Energy Efficiency Improvement Progress

In 1988, the petroleum refining industry achieved a 5.7% net reduction in energy consumption relative

to 1985. Compared with the original base year of 1972, the improvement is 31.3%, surpassing the 1990 goal of 30%.

The improvement was achieved in the face of a steady increase in processing intensity resulting from such factors as continued lead phasedown, increased product desulphurization requirements and further product mix changes. Without adjustment to equivalent 1985 operating conditions, the reduction achieved since 1985 was 4.7%.

Economic Factors Affecting the Industry

Most of the major energy conservation projects derived from process studies conducted in the early 1980's were completed by the end of 1988 and only a few large projects offering rapid returns on investment are planned for implementation in the near future. Continued volatility in crude oil and produce prices is complicating investment decisions regarding energy conser-

vation and other projects. Until refining margins improve further, additional reductions in energy use will likely come from small investment projects and improvements in control and optimization of present facilities.

Any additional processing facilities needed to meet new government regulations will be designed for high energy efficiency, but will consume some additional energy, and will limit the funding available for other projects, including energy conservation projects.

Specific Conservation Activities

1. Operations and Maintenance

The reduction in energy use achieved in 1988 resulted partly from recently completed projects and partly from continued improvement in operating and maintenance practices. Energy conservation equipment installed in the mid-1980's reached the time of requiring additional

maintenance and tuning. Areas of improvement included:

- Close attention to process settings by operators, supervisors, engineers and management;
- Increased direct responsibility for achieving conservation goals assigned to operators and maintenance workers;
- Continued emphasis on training operators and engineers;
- Increased furnace efficiency through combustion control improvements;
- Continued commitment to timely repair of steam leaks, damaged insulation, steam traps, etc., and to heat exchanger cleaning;
- Optimization of steam systems;
- Improvements in energy monitoring and control techniques;
- Application of process optimization techniques.

2. Capital Projects

Some capital investment in energy conservation work occurred in 1988, primarily in the following areas, with close attention paid to achievement of project goals:

- Heat recovery facilities, particularly in crude heat exchangers;
- Improvements in plant automation and control;
- Insulation upgrading;
- Reduction in steam consumption;
- Modifications to raise furnace and boiler efficiencies;
- Facilities to reduce fuel gas production.

3. Technology Improvements

Recent gains in energy efficiency have come partly through application of some of the latest advances in technology. The processes used to upgrade and refine crude oil are complex and the improvements easiest to implement

were among the first to be installed. Accordingly, the industry has a strong interest in applied research and development to attain higher process efficiency. The industry maintains close relationships with scientific and technology research activities worldwide. The types of new technology undergoing rapid development and application include:

- Improved catalysts and additives;
- Facilities to reduce crude oil and product losses;
- New techniques to increase heat recovery;
- Techniques to convert fuel gas components into liquids;
- Advanced computer control and process optimization techniques;
- Sophisticated data management systems;
- Use of high efficiency electric motors;
- Facilities for plantwide monitoring and control of electrical power;
- New types of on-line analyzers;
- Flare gas measurement and recovery.

Task Force Activities

The petroleum industry task force is led by two committees; a steering committee which sets policy, maintains government relations and establishes funding, and a technical committee which reviews industry reporting procedures, receives composite industry data and prepares the annual sector report. The Steering Committee is chaired by G.G. Myers, and the Technical Committee is chaired by N.J. Little.

To protect the confidentiality of data from individual sources, the offices and secretarial services of PACE are used to obtain and consolidate the technical data submitted by the participating refining com-

panies. It should be noted that all costs involved in the activities of the task force are borne by the petroleum refining industry.

The sector does not consider itself suitable to sponsor or conduct educational workshops. However, member companies are encouraged to participate individually in academic and industrial seminars on energy management and conservation.

Future Outlook

Improvements in operating and maintenance practices and implementation of small capital projects applying recent technical advances will continue to receive the strongest emphasis in the near term, and should yield appreciable additional improvements in energy use. In Ontario, introduction of time-of-use electricity rates is forcing development of steps to shift some electrical loads to the low cost night time period.

In the longer term, larger capital expenditures will be required to make further significant progress in energy efficiency in petroleum refining. The investments will proceed if expected rates of return are adequate and capital funds are available. The highly competitive nature of the industry and the need to remain competitive will likely spur the drive toward higher energy efficiency.

Table I

Petroleum Refining Industry Energy Efficiency Improvement

Current year (1988) total energy inputs			293.4 petajoules
New base year (1985) equivalent energy inputs			307.8 petajoules
Gross Improvement	1985 to 1988	4.7%	
Adjustments — (for increased processing severity, changes in product mix, capacity utilization, etc.)			3.2 petajoules
Adjusted base year equivalent			311.0 petajoules
Net Improvement	1985 to 1988	5.7	
Efficiency gain	1972 to 1985	25.6	
Total gain	1972 to 1988	31.3%	

Table II

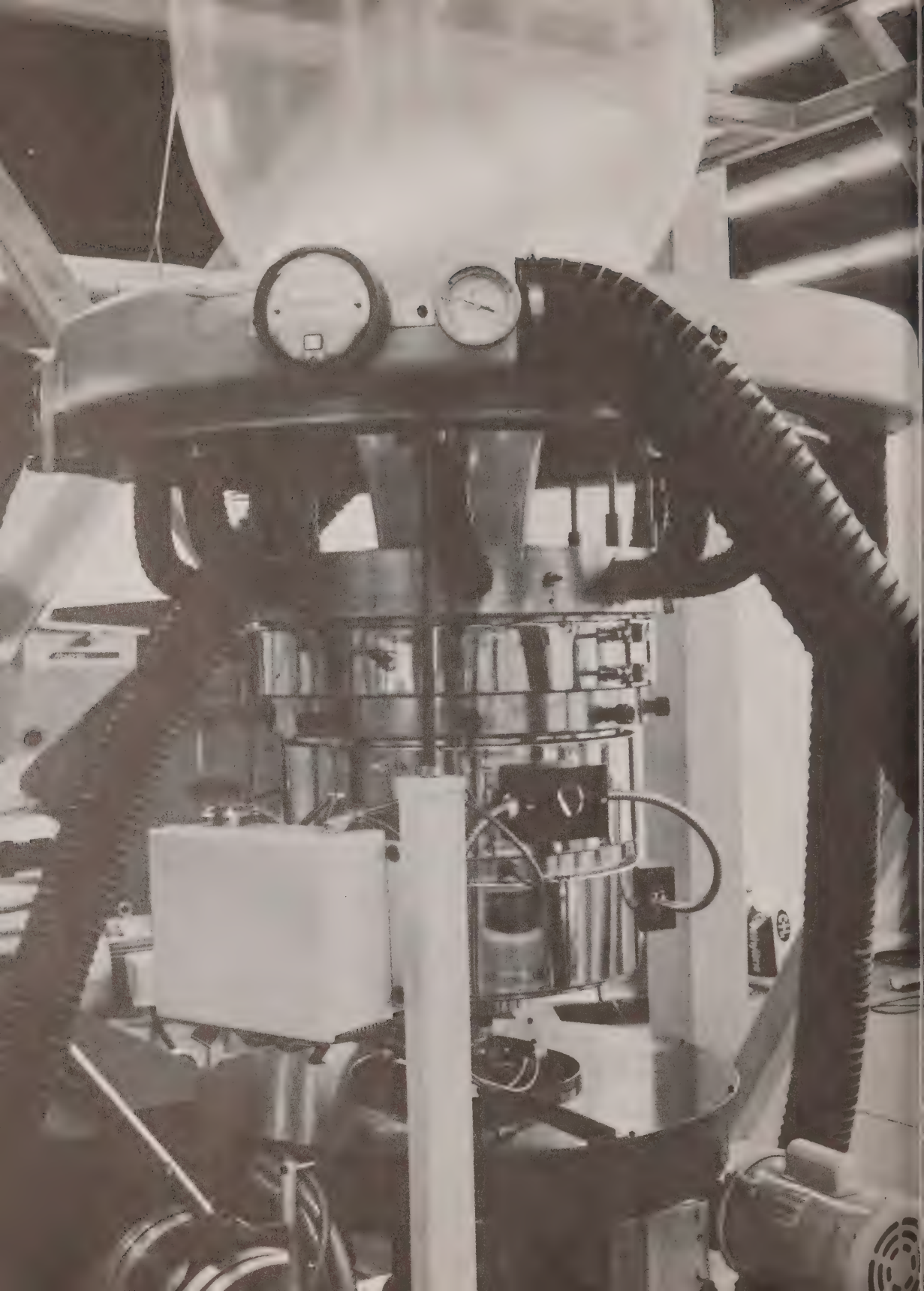
Petroleum Refining Industry Energy Used in 1988

Type	Petajoules	Percent
Natural Gas	47.8	16.3
Electricity (purchased) (a)	41.3	14.1
Liquid Petroleum Products:		
Distillate Oil	—	—
Residual Oil	18.5	6.3
Petroleum Coke	59.0	20.1
Other Fuels:		
LP Gas	1.2	0.4
Refinery Gas	124.4	42.4
Steam (purchased)	1.2	0.4
Total	293.4	100.0

Energy based on (1) company assigned values, (2) measured thermal values,
or (3) U.S. Bureau of Mines values as follows:

Applied Conversion Factors

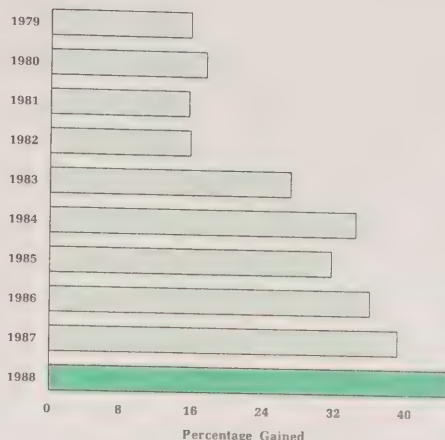
Crude Oil	37.660 GJ/m ³
Distillate	38.655 GJ/m ³
Residual	41.721 GJ/m ³
LPG	26.617 GJ/m ³
Natural Gas	38.414 GJ/m ³
Refinery Gas	36.888 GJ/m ³
Petroleum Coke	38.030 GJ/kg
Coal	27.935 GJ/kg
Purchased Steam	2.791 MJ/kg
(a) Purchased Electricity	10,551 MJ/kWh



Plastics Processing Industry

Energy Conservation Task Force

Dr. Tom Deans
Chairman



This report is based on a survey of the processing sector of The Society of the Plastics Industry (SPI) of Canada. The group consists mainly of independent extruders, injection and blow moulding operators and film producers. Not included in this survey are the resin suppliers, compounders, distribution companies, equipment makers and a large number of processing operations that are an integral part of other manufacturing industries, e.g., automotive.

The plastics industry is the fourth largest manufacturing industry in Canada with about \$11 billion in Gross Domestic Product (GDP) and 3,000 employees. Since 1975, consumption of plastic products has grown by an average 8% per year.

Energy Performance

Energy use per unit of production by the surveyed companies improved 5.5% in 1988, boosting total gain to 13.5% over the new 1985 reference year and 45% above the consolidated 1980 base year. At this rate, the 50% improvement goal set for 1990 should be achieved one year earlier than expected.

It is estimated that the 52 participants, operating some 70 plants, spent \$21.9 million for fuel and elec-

tricity during 1988. In this mix, the 51% electricity energy share accounts for 77% of total cost. Some plant sites depend solely on electricity, especially in Quebec where marketing incentives provide cost advantages over use of fossil fuels. In these plant sites, electricity is used, not only for motive power, but also for raising steam and process heating.

Natural gas accounted for 44% of the participants' energy consumption and 19% of total energy cost. These energy consumption versus cost ratios reflect mainly the impact of Ontario prices since over one-half of the plastics processing industry is located in that province.

Only minor quantities of fuel oil, amounting to 2% of total energy consumption, are used for a number of different reasons. For some, such as the Maritime provinces, it is the only convenient fuel available. For others, fuel oil can be used only when required without regard for preset (natural gas) contract limits. The main consumption, however, appears to be by larger processors where natural gas interruptible contracts require a backup fuel source.

Rising consumption of electricity in plants, primarily because of increasing production rates, has resulted in less fuel required for heat-

ing facilities. In fact, many densely packed injection moulding operations continue to exhaust vast quantities of heat year-round because there is no place to reuse it. In the past 9 years, the electrical energy share in processing plants has grown from 40% to nearly 51% of total consumption. In the same period the natural gas share has dropped from 55% to 44%, with consumption of other fuels remaining essentially stable.

Factors Impacting 1988 Performance

The plastics processing industry continues to experience a relatively high energy efficiency improvement rate for a number of business and technical reasons:

The plastics processing industry is the fastest growing sector in the Canadian manufacturing industry with a recent growth rate of some 8%. Real Gross Domestic Product (GDP) has doubled since 1971. To satisfy this outstanding growth rate, annual capital spending on new construction, and more efficient machinery and equipment has grown from \$60 million in 1975 to more than \$250 million in 1988. Even higher annual energy efficiency improvement rates would be registered in this fast growing industry if the purpose of the new equip-

ment was to replace older inefficient equipment rather than for expansion.

What's more, to help achieve greater production demands, capacity utilization rates escalated from a low of 75% in the 1982 recession to a peak of 100% in late 1987. In 1988, capacity receded slightly to 92% at the end of the year, according to Industry, Science and Technology Canada figures, but general utilization rates nevertheless remain in a highly efficient operating range. In this high utilization situation, continued healthy capital spending is justified and further efficiency improvements will ensue.

The trends shown in Figure 1 reveal that efficiency increases have not kept pace with the growth in production. This may have occurred for a number of reasons. For instance, smaller operators tend to rent factory space from realtors who are not generally concerned about energy efficiency. In other cases, many businesses have grown so fast that obsolete equipment is still being used and/or some equipment is pushed beyond optimum design efficiencies. As well, plastics processing is an endothermic process with varying degrees of plasticizing efficiency and heat loss.

Survey responses indicate that energy is considered a "medium" and "increasingly" important production cost factor. This concern reflects the thinking of the majority of participants who are injection moulders with energy versus manufacturing cost percentages of about 20%. Those using extrusion and blow moulding processes tend to be somewhat less concerned because of lower energy/cost ratios in the 10% to 15% range while film-making and coating operators expect costs in the 8% to 10% range.

Two-thirds of the reporting companies had annual energy costs in the \$100,000 to \$500,000 range. Many of the firms in this category are able to dedicate equipment to long-running production stretches, have made energy management the responsibility of production or

engineering managers, and generally perform some energy monitoring through their cost accounting departments. These are the companies that most often show the highest efficiency improvement and have an "increasing" concern toward energy efficiency.

A growing number of survey participants have energy costs above \$1 million because of company mergers, increased production capacity and rising energy prices. Many of these companies employ highly trained plant engineers responsible for energy efficiency and conservation.

Leading processors in this category are starting to take a more thorough look at their manufacturing productivity rates. This is evident in comments made by those in the process of upgrading their energy monitoring systems, some of which are forerunners of real-time data acquisition systems (DAS) and, eventually, to total computer aided manufacturing (CAM) control.

The technical improvements that have resulted in efficiency improvements are sometimes very complex, given the advanced technologies used throughout this industry. Comments from the surveys described basic actions as well as the difficult areas where lucrative savings are being achieved. In the basic category, common remarks were the upgrading of HVAC and boiler operations, lighting, cooling towers, compressed air systems, insulation, steam traps, etc. In the second category, installation of programmable logic controllers (PLC), replacement of gas unit heaters with infra-red heaters to reduce air flows, and installation of high-efficiency motors on older extruders were mentioned.

Since electricity is the dominant expense it is drawing increased attention. From a recent study¹ of consumption in a injection moulding operation, electrical use was distributed as follows:

Injection moulding machine	65.0%
Raw material handling	0.7%
Chillers	5.5%

Cooling Towers	2.0%
Air Compressors	3.5%
Plant Lighting	4.1%
Ventilation	0.2%
Air Conditioning	6.5%
Mould Maintenance	3.4%
Machine Maintenance	3.4%
Secondary Operations	1.7%
Office use	3.4%

Electrical consumption in the injection moulding process varies considerably because of machine design and age, clamping capacities, resins processed, etc. However, the injection screw drive often requires 30% to 50% of cycle input, cylinder heating 10% to 40%, while the hydraulic system accounts for 40%. On the output side, mould cooling often carries away 20% of the converted energy to cooling towers while extruder convection and radiation losses amount to 15%. Overall operating efficiencies of many injection moulding processes are thought to be in the 15% to 25% range.

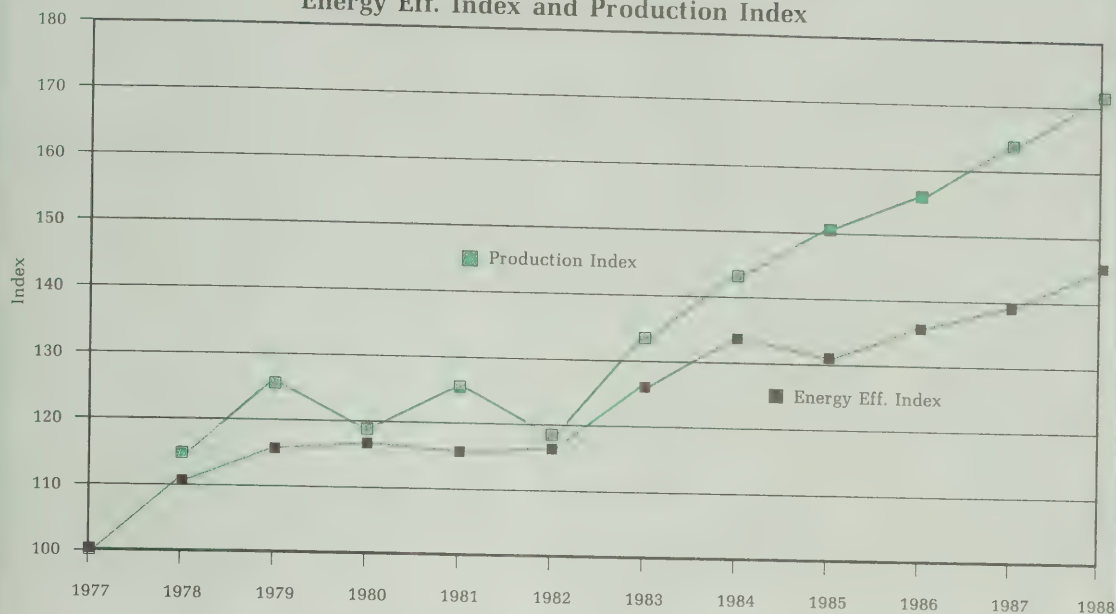
Estimates of efficiencies for the continuous extruding process can be as high as 40% to 60% depending on the resins and nozzle heating systems. Most extrusion manufacturers agree that solid state D.C. drives with helical gearing provide the most efficient results.

Canadian machinery manufacturers have made significant efficiency improvements in their designs to stay competitive with manufacturers in Japan and Germany where designs are based on electrical costs that are three to four times higher than Canada's. Installation of microprocessors to sequence machine operation, minimize screw speeds and optimize clamping capacities according to resin quality and cycle times, are fairly common practices. Many operations have become completely automated and only shut down when production quantities are satisfied or maintenance is required.

¹ "Energy Consideration in Planning an Injection Moulding Operation", Rodolfo Selem, Systems Engineer, Husky Injection Moulding Systems Ltd. 1982

Figure 1

Plastics Processing Industry Energy Eff. Index and Production Index



Source: Statistics Canada #31-003, CIPEC reports.

Table II

Plastics Processing Industry Energy Use

Type	Units	Terajoules	Percentage Distribution		
			1988	1987	1979
Electricity	377,152 MWh	1,357.8	50.8	49.5	40.0
Natural Gas	31,756,357 m ³	1,181.3	44.2	47.2	55.5
Liquid Petroleum Products:					
Distillate Oil	1,408,683 L	55.1	2.1	0.5	1.0
Residual Oil	1,165,200 L	47.2	1.7	2.1	3.0
Diesel & Gasoline	373,588 L	14.8	0.6	0.3	0.2
Other Fuels:					
Propane	446,380 L	11.9	0.6	0.4	0.3
Total		2,668.1			

Performance Statistics

Current year total energy inputs: 2,668.1 Terajoules
 Base year (1985) equivalent inputs: 3,083.6 Terajoules

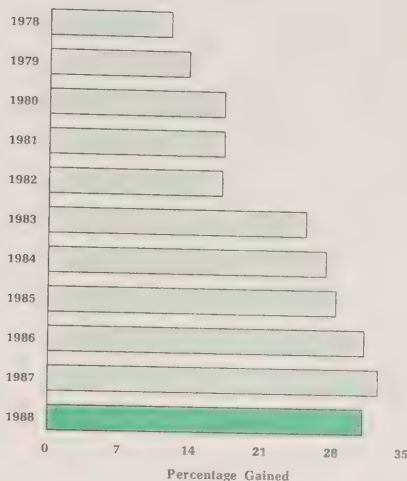
Efficiency Improvement 1980 to 1985 = 31.48%
 1986 = 4.35%
 1987 = 3.63%
 1988 = 5.49%
 Total 44.95%



Pulp and Paper Industry

Energy Conservation Task Force

M.J. Frost
Chairman



Director Description

The Canadian Pulp and Paper Association's Energy Monitoring Report covers 123 mills accounting for about 98% of the total pulp, paper and paperboard produced in Canada in 1988. Six of the mills included in the report are not members of the Association. A list of participating companies appears at the end of this annual report.

Progress Toward Improved Energy Use Efficiency

Overall energy use efficiency of the Canadian pulp and paper industry continued to improve in 1988. However, purchased energy per ton of product increased slightly during the year, with the result that the reduction in purchased energy since 1972 now represents 31.3% versus the industry's objective of 33% reduction for the year 1990. This objective had been attained in 1987.

The major energy source continues to be purchased electricity which accounts for 43.9% of the

total purchased energy. Heavy fuel oil has shrunk to 24.5% of the total, which is 34% of the amount used on an equivalent production basis in 1972.

On a unit energy basis, there was a reduction in the use of purchased electricity in electric boilers, but this was more than offset by increases in the use of heavy fuel oil and natural gas. Purchased electricity for motive power continued to increase in 1988, reflecting the trend of gradual replacement of sulphite pulping with mechanical pulping processes, particularly in news-mills.

Self-generated energy usage per ton of product declined during 1988, with the result that total energy usage per ton of product declined.

The reduction in heavy fuel oil use is equivalent to 3.78 billion litres, and in total purchased energy use is equivalent to 3.57 billion litres of heavy fuel oil when compared to the base year of 1972.

Operating Conditions

Production for 1988 was a record for the industry. Shipments of pulp and paper by the Canadian industry rose by 2% over 1987, with printing, writing and sanitary grades showing the largest increase. The industry as a whole operated at 98% of capacity for the year.

Replacement of fossil fuels with wood wastes generated by the industry and neighbouring wood products operations levelled off during the past year. These wood wastes now account for 67% of the total fuels burned by the industry. Waste fuels plus captive hydraulic power account for 55% of the total energy used, up from 42% in 1972.

Technological Developments

Many of the projects in PAPRICAN's research program have integral energy conservation objectives and result in the generation of technological concepts that yield potential reductions in energy consumption and

improved overall energy management.

As a continuation of the efforts by PAPRICAN to help solve sludge disposal problems, tests are being carried out in a project partly funded by Energy, Mines and Resources Canada to assess the technical and economic viability of drying pulp and paper mill sludges directly with oil as the heat transfer medium, and vapour recompression applied to the evaporated water as the source of heat. The objective is to obtain a very low moisture content fuel with high heating value, that can be used in combination fuel fired boilers and even lime kilns, thus alleviating disposal problems as well as reducing the mill's purchased energy requirements.

An experimental apparatus was built to carry out batch drying tests of sludges suspended in oils at temperatures up to 150°C and filtration of the sludges from the oil at close to drying temperature. The tests were carried out with newsprint and kraft mill sludges using bunker C and tall oil as drying media. The range of drying temperatures tested was 100°C to 130°C.

Product moisture contents of less than 5% (wet, oil-free basis) were obtained at relatively high drying rates, with temperatures of around 110°C and residence time of about four minutes.

It was found that due to its low flash point (approx. 66°C) bunker C oil is not a suitable drying medium.

At drying temperatures above 100°C a substantial amount of volatile compounds are lost with the condensate. This will result in:

- (i) a sizeable amount of fuel loss
- (ii) a potential fire or explosion hazard if mixed with air
- (iii) a significant implication on the BOD and toxicity load of the mill effluent.

Tall oil appears to be a more favourable drying oil since its flash point is above 200°C and all of the above adverse effects are minimized.

Table I

Pulp and Paper Industry Energy Efficiency Improvement

Current year (1988) total energy inputs	334.95 x 10 ¹⁵ Joules
Base year (1972) equivalent energy inputs	487.68 x 10 ¹⁵ Joules

$$\begin{aligned} \text{Improvement} &= \frac{\text{Base year equivalent} - \text{current year inputs}}{\text{Base year equivalent}} \times 100 \\ &= \frac{487.68 - 334.95}{487.68} \times 100 = 31.3\% \end{aligned}$$

Adjustments — None

Survey Data

Number of companies in 1988 report	62
Number of plants in 1988 report	123
Current year consumption	334.95 X 10 ¹⁵ Joules
Current year production	26,341,937 tonnes
Base year consumption	354.29 X 10 ¹⁵ Joules
Base year production	19,136,895 tonnes
Base year volume equivalent consumption	487.68 X 10 ¹⁵ Joules
1990 goal (relative to 1972 base year)	33%

Table II

Pulp and Paper Industry Purchased Energy Consumption

Energy Source	1972* Joules X 10 ¹⁵	Percentage of Total	1987** Joules X 10 ¹⁵	Percentage of Total	1988** Joules X 10 ¹⁵	Percentage of Total
Coal	16.98	3.5	4.77	1.5	4.86	1.5
Petroleum Products:						
Residual Oil	240.01	49.2	69.01	21.6	81.92	24.4
Distillates	8.87	1.8	4.72	1.5	4.76	1.4
Natural Gas	98.22	20.2	86.25	26.7	94.02	28.1
LPG	0.98	0.2	0.78	0.3	0.89	0.3
Other	5.05	1.0	1.65	0.5	1.41	0.4
Electricity (purchased)	117.57	24.1	152.79***	47.9	147.09****	43.9
Totals	487.68	100.0	318.98	100.0	334.95	100.0

*Reported on 1972 unit use adjusted to 1988 production

**Actual Use

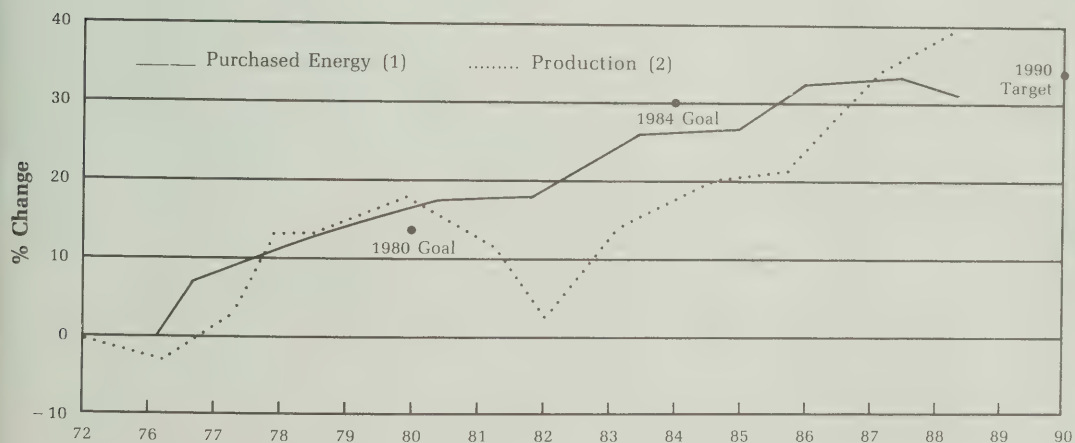
***32.92 X 10¹⁵ Joules (10.3%) used in electric boilers

****21.56 X 10¹⁵ Joules (6.4%) used in electric boilers

Figure I

Pulp and Paper Industry Purchased Energy Use Efficiency Improvement vs Production

Percentage Change – 1972 through 1988



1. % Decrease in Purchased Energy/Tonne
2. % increase in Production vs Base Year



Textile Industry

Energy Management Task Force

Luis G. Monton
Chairman

Efficient energy management combined with a good production year resulted in an energy consumption improvement of 5.0% per kilo of product in the primary textile industry during 1988. The primary textile industry shipped goods valued at \$6.7 billion during 1988 and employed roughly 60,200 Canadians.

When most people think of the primary textile industry they think of the clothes they wear and the sheets they sleep on. While the primary textile industry does provide the cloth used to dress Canadians and furnish their homes, it also does much, much more. The primary textile industry ships over half of its annual production to more than 150 manufacturing industries. Geotextiles are used to help stabilize airport runways and major highways. In new construction textile fabrics are used as air barriers to improve energy efficiency. Fire hoses, safety harnesses, upholstery, vinyl coated products, seatbelts and some wallpapers as well as cords, cordage and twine, are more examples of primary textile products.

Primary textile products include both natural and synthetic fibres. Some of the processes involved in their production include spinning and weaving, bleaching, printing

and drying. These are processes which depend on the consumption of energy. The Textile Industry Energy Management Task Force of the Canadian Textiles Institute works hand-in-hand with the industry and Energy, Mines & Resources to help make the use of that energy more efficient.

Over 60 of Canada's most important primary textile producers take part in the task force and their production accounts for more than 90% of Canada's primary textile output. The task force includes those companies that sell their products directly to other manufacturing industries as well as those which sell finished products such as drapes, carpets, upholstered goods, knitwear and blankets for consumption at home and abroad.

1988 Performance

Energy efficiency in the primary textile industry improved 5.0% during 1988. When this figure is added to the improvements posted between 1974 and 1987, it brings the total percentage gained in energy efficiency to 31.6%, 2.6% above the target set by the Textile Task Force for 1990. While this is an impressive gain it should be remembered that to a large degree it was the result of a buoyant economy driving the mills

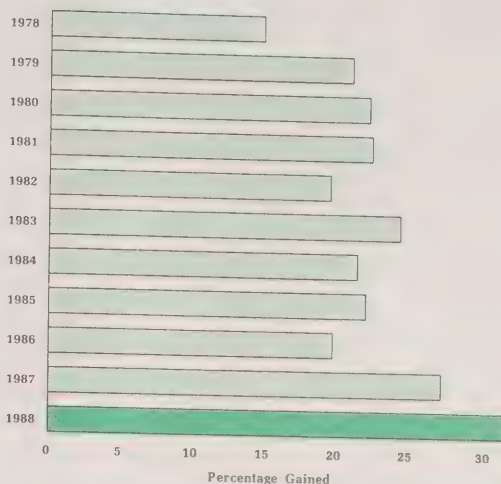
to near capacity utilization. The value of goods shipped by the primary textile industry rose to \$6.7 billion in 1988 over \$6.1 billion in 1987.

While the industry is doing well now, its future is not assured. Faced with the economic uncertainty created by the prospect of increased imports, and influenced by relatively cheap oil, producers feel that introducing the new generation of energy efficient technologies will have to be justified by more certain economic returns.

These factors have created a situation where energy project paybacks must be short and most energy gains are made through vigilant, energy efficient housekeeping and maintenance.

Task Force Activities

During 1988 the task force made a number of significant changes in the way it operates and laid the foundation for further changes in 1989. These changes were designed to bring home the necessity for increased energy efficiency awareness and improve the dissemination of practical energy efficiency techniques.



In 1988 the Energy Conservation Task Force changed its name to the Energy Management Task Force. This was done to change perception more than fact. The problem presented by the term "energy conservation" is that it carries a negative connotation. To some, it implies a forced lessening of the available energy supply. To others, it flies in the face of the fact that a certain amount of energy will always be needed to produce a certain amount of product — no matter what the ratio.

To combat these negative concepts, the textile group has changed its name and the name of its committees and publications from "Energy Conservation" to "Energy Management". This has been done to better reflect the sound logic that wise energy management translates into lower production costs and higher profit margins. As well, the task force decided that in 1989, it would hold its meetings in scientific and industrial settings where new energy efficient machinery could be studied first hand.

In 1988 the Textile Energy Management Task Force issued a series of three messages to CEO's in the industry. These short memoranda were designed to help raise energy efficiency consciousness by showing the direct influence wise energy management has on the bottom line.

The Textile Energy Management Task Force is divided into two committees; the Energy Management Committee and the Technical Liaison Subcommittee. The Energy Management Committee is responsible for raising awareness of the need for greater efficiency in the primary textile industry as a whole. The Technical Liaison Subcommittee is responsible for showing plant managers and the people on the floor how to do it. The committees are made up of representatives of the textile industry, public and private utilities, and energy consultants.

Jointly they issue two sets of publications which over the years have served as models for other CIPEC task forces. The first, "Energy Man-

agement Notes", is designed as a general interest energy efficiency newsletter. It provides a synopsis of energy efficiency news and details the effects of new regulations and energy programs on the textile industry. As well, the publication lists upcoming events and seminars which will be of interest to energy managers.

The second, "Energy Management Techniques" is a technical publication which uses case histories from the textile industry to show how important energy gains can be made. Both publications emphasize that energy efficiency is a valuable tool for improving profit margins.

In 1988 the Technical Liaison Subcommittee organized two seminars on steam, one in English and one in French. The excellent manuals produced by Energy, Mines & Resources were used to form the basis of the seminars. Different aspects of how to make steam and condensate handling systems more efficient were presented by a cross-section of consultants and personnel from the textile industry and public and private utilities. As always, case histories provided by the participants were used as the basis for a round-robin problem solving session held at the end of each seminar.

While the nature of the seminars scheduled for 1989 is not confirmed as yet, the Technical Liaison Subcommittee is convinced that they will be as successful in providing information on cutting energy costs as those in the past have been.

Case History

One primary textile operation which consumes large amounts of energy is the drying of fabric. In the past this has largely been done by using steam heat exchangers as a drying mechanism. Recent studies have shown, however, that direct-fired natural gas heating of tenter frames can reduce energy consumption by 35%, increase productivity by 15% and provide better quality finished goods.

Against these advantages lies the fear that fabric colour degradation occurs with direct-fired tenter frame heating, although studies conducted in 1975 showed that, if the air circulating in the tenter frame is kept below 450°C, this will not happen.

The main advantage to the direct-fired natural gas system is that lower calorific values, energy efficiency is 100%. This is against the 65% estimated best efficiency rating for boiler fed heating systems. Boiler systems lose efficiency through boiler combustion losses, stack losses, radiation losses and distribution line losses.

In a feasibility study conducted on a 1.4 million BTU dryer, it was found that it would cost \$85,000 to convert to natural gas direct-fire heating. This price included bringing in the new gas lines. In return, the finishing plant would save \$15,000 a year in energy costs and gain 15% more production.

Another benefit of direct-fired gas heating is that it can save large sums in manpower costs. When these are combined with energy savings they provide an extremely short payback period. Consider a finishing plant boiler that supplies 85,000 lbs. of pressure per hour. By installing direct-fired dryers, the required boiler pressure can be reduced to 40,000 lbs. or less. This means that the boilers will no longer have to be continuously supervised by stationary engineers. This can result in a possible saving of \$100,000 or more per year in manpower costs.

Energy Use Patterns

Energy use patterns in the primary textile industry barely change during 1988. While the amount of energy per kilo of product dropped by 9.5%, the proportions of oil, natural gas and electricity remained stable. This indicates that producers do not believe that investments in new technologies are economically justified at this time and are concentrating their energy management activities on projects with short payback periods.

Future Outlook and Concerns

The primary textile industry has now met and surpassed its 1990 target for energy efficiency improvement. Because much of the gain was the result of the industry working at near full capacity it is still to be seen how much of this gain can be retained in coming years.

Due to uncertain conditions in the industry, the Textile Energy Man-

agement Task Force will continue to stress that significant energy gains can be made through routine maintenance operations and housekeeping.

We will also continue to emphasize the financial gains that can be made through improved energy efficiency and illustrate those gains through the publication of practical case histories and the organization of relevant seminars.

CIPEC has been an effective program since its beginning. The Energy Management Committee of the Canadian Textiles Institute hopes that all levels of government will continue their support of CIPEC, and in this way match the time and labour spent by industry to make sure that this successful program continues.

Table I

Textile Industry Energy Efficiency Improvement

Total (1988)		8,242,073 gigajoules
New base year (1985) equivalent energy inputs		9,107,491 gigajoules
Net Improvement	= 9.5%	
Adjustments	— None	
Efficiency gain 1974 - 1985	22.1	
1986	-2.3	
1987	6.8	
1988	5.0	
Total gain 1974 - 1988	31.6%	

Table II

Textile Industry Energy Use

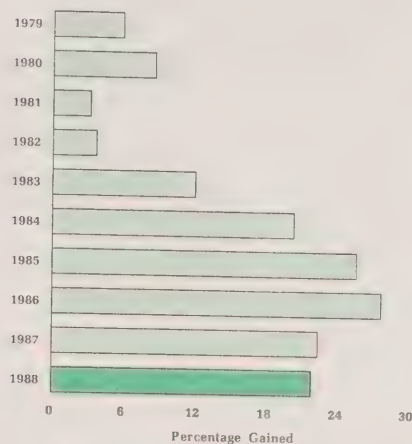
Type	Units	Gigajoules	Percentage of Total Consumption		
			1988	1987	1986
Natural Gas	121,753,000 m ³	4,529,212	55.0	55.6	52.5
Electricity	803,731 MWh	2,893,431	35.1	35.8	36.7
Liquid Petroleum Products:					
Distillate Oil	468 kL	18,252	0.2	0.1	0.1
Residual Oil	17,743 kL	750,528	9.0	7.6	9.8
Diesel & Gasoline	348 kL	13,241	0.2	0.2	0.2
Other Fuels:					
Propane & LPG	1,200 m ³	31,875	0.4	0.4	0.5
Other Gaseous Fuels	110 m ³	5,533	0.1	0.3	0.2
Total (1988)		8,242,073			



Transportation Industry (Manufacturing)

Energy Management Task Force

John Hatcher
Chairman



Task Force Profile

The Transportation Industry (Manufacturing) Energy Management Task Force has a membership of 580 companies from the following six participating trade associations:

Aerospace Industries Association of Canada (AIAC)

Allied Boating Association of Canada (ABAC)

Automotive Parts Manufacturers' Association (APMA)

Canadian Maritime Industries Association (CMIA)

Canadian Truck and Trailer Manufacturers' Association (CTTMA)

Motor Vehicle Manufacturers' Association (MVMA)

There are 96 companies reporting energy usage for 1988, an increase of 66% over the 58 companies which reported in 1987. Energy use reported by these companies represents some 80% of the total energy used by the transportation (man-

ufacturing) sector. While 47 new companies reported this year, the energy efficiency changes continue to be dominated by a few very large energy consuming manufacturers concentrated in the MVMA sub-sector. All of these large energy-using companies practice organized energy management and conservation.

Task Force Activities

It is the belief of the task force that company participation in the CIPEC energy reporting process will result in an increased awareness of energy consumption patterns at the company operating level, and that this awareness will result in increased efforts to control energy costs and improve energy efficiency. Towards this end, over the past year the task force has concentrated its efforts on developing a simplified data collection form. This simplified form, in conjunction with the use of an experienced representative to encourage and assist companies in prepar-

ing their data collection reports, is credited with the significant increase in 1988 reporting companies.

The Idea Exchange newsletter published by the task force and distributed to over 600 energy managers continues to be a popular communication tool which keeps sector companies abreast of energy-related matters.

Energy Use Patterns

Natural gas continues to increase its share of total energy consumed by our sector, increasing to 57.9% in 1988, up from 56.7% the previous year, and from the 1980 share of 49.1% shown in the Energy Use Table. This increase in share appears to be at the expense of electricity, which dropped to 31.5% in 1988, down from 32.8% in 1987. This apparent shift in energy usage may be a result of the reductions in the price of natural gas over the past two years.

Performance

As shown in the Sector Performance Table, three task force sub-sectors continue to report gains in energy efficiency, showing improvements of between 1.9% and 4.6%; two sub-sectors show almost no change in their energy efficiency; while one sub-sector shows a decline of - 6.7%.

Overall, compared to the base year of 1985, adjusted for changes in levels of output, the 1988 task force report shows a decline of - 3.5% in energy efficiency. This figure is similar to the 1987 decline of - 3.3%.

The decline in energy efficiency for 1988 is primarily attributable to a very few companies in the dominant Motor Vehicle Manufacturers' Association sub-sector, where lower production volumes due to model changes and production line retooling have had a significant negative impact on energy efficiency.

Companies in several sectors have reported that gains in energy efficiency resulting from improvements to processes and energy conservation measures have, in some instances, been offset by increased energy usage of heating and ventilating systems needed to meet increasingly stringent air quality requirements, driven by the current emphasis on occupational health and safety. It is noteworthy that many of these new heating and ventilating system installations had energy efficiency specified at the time of procurement.

Additionally, a number of companies have reported a continuing trend towards more automation and robotics in their manufacturing processes, and to more computers in their office environments. These long-term changes will result in more energy-intensive operations.

Subsector Performance

Sector Performance showed continued improvement in energy efficiency of the Aerospace Industries Association of Canada with a gain of 2.8%.

The Automotive Parts Manufacturers' Association of Canada achieved an excellent gain of 4.6%.

A gain of 1.9% is reported by the Canadian Maritime Industries Association.

These three sub-sectors show a combined energy efficiency improvement of 3.9%.

The Allied Boating Association of Canada and the Canadian Truck and Trailer Manufacturers' Association show almost no change in their energy efficiency, with changes of 0% and - 0.2% respectively.

The decline in energy efficiency of - 6.7% for the Motor Vehicle Manufacturers' Association does not reflect the energy conservation efforts of its member companies. The results reflect changes in production volume of some sub-sector companies caused by model changes and retooling activities, during which time the plants consume significant amounts of energy with almost zero output. In fact, several MVMA sub-sector companies show a definite improvement in energy efficiency. All major energy using companies in this sub-sector report continued efforts to improve their competitive position through better energy management programs.

Future Outlook and Concerns

The task force anticipates an improvement in the capacity utilization of the MVMA sub-sector during 1989 and 1990. This will result in a significant improvement in our overall energy efficiency of 10% in 1990 compared to the 1985 base year.

The participating companies in the transportation (manufacturing) sector continue to promote energy conservation as a means of improving their competitive position. The 66% increase in participation in the 1988 survey over 1987 participation is a reflection of increased interest in energy management and reflected better data collection by the task force. This increased participation in the CIPEC energy reporting process and the awareness of energy efficiency and its related costs brought about by participation will, in the opinion of this task force, result in efforts to improve energy efficiency by the participating companies.

The task force believes that energy management is an issue for the 1990's - in terms of the competitive position of our sector companies and also because of the concern for the environment. CIPEC is the vitally needed communication tool providing a link between the vast industrial network and government. With effective energy management and communication industry will be in a better competitive position and will be better able to contribute to a cleaner environment.

Table I

**Transportation Industry (Mfg.)
Energy Efficiency Improvement**

Current year (1988) total energy inputs	46,601,739 gigajoules
New base year (1985) equivalent energy inputs	45,020,229 gigajoules
Net Improvement = -3.5%	
Efficiency gain 1978 - 1985	25.6
1986	2.1
1987	-5.4
1988	-0.2
Total gain 1974 - 1988	22.1%

Table II

**Transportation Industry
Energy Use**

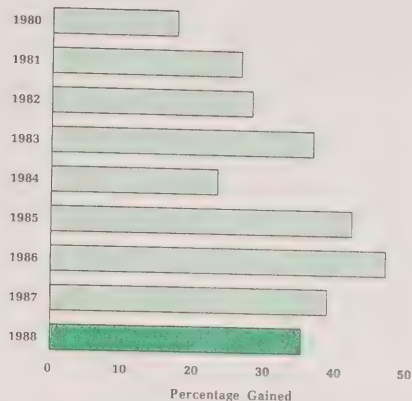
<u>Type</u>	<u>Units</u>	<u>Gigajoules</u>	<u>Percentage of Total Consumption</u>		
			<u>1988</u>	<u>1985</u>	<u>1980</u>
Natural Gas	725,550,321 m ³	26,990,472	57.9	54.7	49.1
Electricity	4,076,839 MWh	14,676,620	31.5	30.1	23.6
Liquid Petroleum Products:					
Distillate Oil	14,730 kL	574,502	1.2	1.2	0.7
Residual Oil	18,953 kL	768,045	1.7	2.1	14.7
Diesel & Gasoline	1,925 kL	74,034	0.1	0.3	0.5
Coal	30,105 tonnes	818,555	1.8	3.6	5.9
Coke	92,253 tonnes	2,491,436	5.4	7.4	5.1
Other Fuels:					
Propane	7,616 kL	202,578	0.4	0.6	0.4
LPG	203kL	5,498	0.1	—	—
Total (1988)		46,601,739			



Wood Products Industry (Western)

Energy Conservation Task Force

C. Bryan
Chairman



Task Force Description

The Wood Products Industry (Western) Task Force was formed by the Council of Forest Industries of British Columbia (COFI) in 1978 and represents 80 companies with more than 100 sawmills and 15 plywood and veneer mills. COFI members and affiliates account for more than 90% of the total product value of the forest industry in B.C.

Most mills in western Canada are members of industry trade associations which actively pursue a wide variety of business issues of common interest. In British Columbia, the major forest industry associations are the Council of Forest Industries of B.C., its Northern Interior Lumber Sector (NILS), the Cariboo Lumber Manufacturers' Association (CLMA) and the Interior Lumber Manufacturers' Association (ILMA). CLMA and ILMA are also affiliate members of COFI.

This survey covers 56 operating sawmills owned by 20 companies,

which accounted for 43% of the lumber produced in B.C. in 1988. The coverage in 1988 represents a substantial increase over the 1987 survey which accounted for 36% of B.C. production. In addition to B.C. mills, the report includes several Alberta sawmills for the first time. The reporting sample covers mills of all sizes and represents all regions in B.C. as well as the above-noted mills in Alberta.

Goals and Progress to Date

The industry's goal for 1990 is a 7% overall increase in energy efficiency from the 1985 base year performance. Although the industry's overall average efficiency in 1988 vs. 1985 (-3.7%) represents an improvement over the performance achieved in 1987 (-5.1%), it is still below the 1985 base year level. The results do, however, show an improvement of 41.1% over the 1978 base year.

Average electrical energy consumption for the production of

green lumber lost ground in 1988 and was 8.5% more than in 1985. Compared with 1978, however, the 1988 performance represented a 12% improvement.

Although average natural gas consumption in the kiln drying of lumber in 1988 improved substantially compared to the year before, it was barely even with the 1985 base year performance. Compared with the 1978 base year, however, there was an improvement of over 54%.

The size of our reporting sample has increased substantially this year. The total for green lumber produced in the 1988 sample was 20% greater than the 1987 sample. The reporting sample for kiln-dried lumber in 1988 was over 40% larger than the previous year's sample, an even more dramatic increase.

There is no obvious, single reason why the electrical energy use in mills converting logs to green lumber rose in 1988. Part of the

explanation for this decline in energy efficiency, however, may lie in the substantial increase in stumpage charges faced by the industry in 1988 and a focus of attention on achieving cost reductions in areas felt to be more significant than electrical energy costs. Total energy costs, as a proportion of all costs ranged from about 1.5% in B.C. coastal mills up to about 3.5% in some B.C. interior mills. Electrical energy costs alone would likely be closer to the 1.5% of total costs experienced in coastal mills where most lumber is not kiln-dried.

In the interior of the province it is customary to kiln-dry lumber using either natural gas or wood waste energy systems. When natural gas prices were rising, through the late 1970's and early 1980's many mills switched from natural gas to wood waste energy systems. Recently, mainly as a result of deregulation, natural gas prices have been falling, making that fuel more attractive. In 1988, mills which could take advantage of deregulation saw natural gas prices decline as much as 30%. Thus, another explanation for declining energy performance regarding natural gas had to do with falling prices which lessened the incentive to switch to wood waste and may have caused some mills to increase natural gas use rather than make use of wood waste.

The phenomenon of price declines due to deregulation will not alter the fact that over the longer term, natural gas prices can be expected to rise, eventually restoring the incentive for wood waste conversions.

Task Force Activities

COFI continues to provide a secretariat/coordinating role regarding the B.C. wood products industry's energy initiatives. Typically, these activities focus on regulatory matters or other aspects concerning the terms and conditions of energy supply.

Activities in 1988 centred on the proposed natural gas pipeline to Vancouver Island and the possibility of replacing heavy fuel oil, local and imported, with natural gas. Energy conservation related activities were largely limited to collecting, analysing and reporting the energy performance data contained in this report.

Future Outlook

The wood products sector is experiencing a reduction in demand as a result of reduced housing starts in North America. Lumber consumption is expected to slow further, in line with anticipated slower economic growth in both Canada and the United States.

Concerns regarding increased stumpage must be addressed in the context of a cyclical downturn in the industry. Unfortunately, producer revenues have also been cut significantly due to the rising value of the Canadian dollar vis-a-vis the U.S. dollar.

These issues lead to considerable uncertainty regarding the short-term outlook for the industry. Over the longer-term, western sawmills will gradually attempt to reduce their output of construction lumber, a commodity product, and to replace that production with higher value-added products.

Wood Products Industry (Western)

Energy Efficiency Improvement

Green Lumber

	<u>1988</u>	<u>1985</u>	<u>1978</u>
Total sample production (million board feet — MMFBM)	6816.8	5052.0	4202.2
Total energy consumption (10^{12} J)	3281.1	2241.5	2297.7
Average electrical energy consumption (10^9 J per MFBM)	0.481	0.444	0.547
Current year total electrical energy inputs (10^{12} J)	3281.1	2241.5	2297.7
Comparison base year (1985) equivalent energy inputs (10^{12} J)	3024.5		
Comparison base year (1978) equivalent energy inputs (10^{12} J)	3727.3		

Improvement (1985 base year) = -8.5%

Improvement (1978 base year) = 12.0%

Kiln Dried Lumber

	<u>1988</u>	<u>1985</u>	<u>1978</u>
Total sample production (MMFBM)	4817.6	3159.4	1013.0
Total energy consumption (mainly natural gas) 10^{12} J	3703.7	2433.0	1708.8
Average energy consumption (10^9 J per MFBM)	0.769	0.770	1.687
Current year total energy inputs (10^{12} J)	3703.7	2433.0	1708.8
Comparison base year (1985) equivalent energy inputs (10^{12} J)	3710.0		
Comparison base year (1978) equivalent energy inputs (10^{12} J)	8123.7		

Improvement (1985 base year) = 0.2%

Improvement (1978 base year) = 54.4%

Combined Energy Performance

	<u>1988</u> <u>Actual</u>	<u>1985</u> <u>Equiv.</u>	<u>1978</u> <u>Equiv.</u>
Total electrical energy consumption (Green Lumber 10^{12} J)	3281.1	3024.5	3727.3
Total natural gas consumption (Kiln Dried 10^{12} J)	3703.7	3710.0	8126.7
Total sector energy consumption 10^{12} J	6984.8	6734.5	11854.0

Improvement (1985 base year) = -3.7%

Improvement (1978 base year) = 41.1%

Reporting Companies

Chemical

Alberta Gas Chemicals Ltd.
 Alby Chlorates Inc.
 Ashland Chemicals Inc.
 Atkemix Inc.
 BASF Canada Inc.
 B.C. Chemicals Ltd.
 B.F. Goodrich Canada Inc.
 Borden Company Limited
 Carlew Chemicals Limited
 Celanese Canada Inc.
 CIL Inc.
 Commercial Alcohols Limited
 Cyanamid Canada Inc.
 Dominion Colour Company
 Domtar Chemicals Group
 Dow Chemical Canada Inc.
 DuPont Canada Inc.
 Emery Chemicals Ltd.
 Esso Chemicals Canada
 G.E. Plastics Canada Inc.
 General Chemical Canada Inc.
 Hart Chemical Limited
 Henkel Canada Inc.
 Himont Canada Inc.
 H.L. Blachford Ltd.
 Hoechst Canada Inc.
 Huls Canada Inc.
 Lubrizol Canada Ltd.
 Monsanto Canada Inc.
 Nacan Products Ltd.
 National Silicates Limited
 Nitrochem Inc.
 NL Chem Canada Inc.
 Novacor Chemicals Ltd.
 Ocelot Industries Ltd.
 Pétrumont Inc.
 Pigment & Chemical Inc.
 Polysar Limited
 Procter & Gamble Inc.
 QuéNord Inc.
 Reed Inc.
 Rohm and Haas Canada Inc.
 Shell Canada Chemical Company
 Sulco Chemicals Limited
 Surpass Chemicals Ltd.
 Tioxide Canada Inc.
 Union Carbide Canada Limited
 Uniroyal Chemical

Electrical and Electronic

3M Canada Inc.
 Allanson, a Division of Jannock Ltd.
 Alcan Wire and Cable Ltd.
 Allen-Bradley Canada Ltd.
 Allied-Signal Aerospace Company,
 Garrett Canada
 Andrews Antenna Co. Ltd.
 Arcair Canada Limited
 Ascoelectric Ltd.
 Black & Decker Canada Inc.
 B.B. Howden Inc.
 Burndy Inc.
 CAE Electronics Ltd.
 Camco Ltd.
 Canada Wire and Cable Ltd.
 Chromalox Inc.
 Commander Electrical Materials Inc.
 Commander Electrical
 Equipment Inc.
 Crouse-Hinds Electrical
 Construction Materials Ltd.
 Eaton Yale Ltd.
 Edwards, a unit of General
 Signal Ltd.
 Erico Canada Inc.
 Federal Pioneer Ltd.
 Furnas Electric Company
 General Electric Canada Inc.
 General Wire & Cable Ltd.
 Genum Corporation
 Gould Shawmut Company Ltd.
 GTE Sylvania Ltd.
 Hamilton Porcelains Limited
 Holophane Inc.
 Honeywell Limited
 Hoover Canada Inc.
 Hubbell Canada Inc.
 Hydrel Engineering Limited
 Inglis Limited
 Iona Appliances Inc.
 ITT Cannon Canada Ltd.
 Klockner Moeller Ltée
 L-Tek Canada Inc.
 Lincoln Electric Co. of Canada Ltd.
 Marine Industrie Limitée
 Motorola Information Systems
 NEI Ferranti Packard Electronics
 Pursley Inc.
 Pyrotenc of Canada Limited
 Sanyo Canada Inc.

Schlumberger Industries, Sangamon
 Electricity Division
 Smith & Stone (1982) Inc.
 Spar Aerospace Limited
 Square D Canada Ltd.
 Temco Electric Products Co. Inc.
 Texas Instruments Canada Limited
 Thomas & Betts Ltd.
 Thomson Consumer Electronics Ltd.
 Trench Electric Ltd.
 WCI Manufacturing Limited
 Westcan Electrical Mfg. Inc.
 Westinghouse Canada Inc.

Ferrous Metals

The Algoma Steel Corporation
 Dofasco Inc.
 Sidbec-Dosco Inc.
 Stelco Inc.
 Sydney Steel Corporation (Sysco)

Food and Beverage

Bakeries

Ben's Limited
 Corporate Foods Limited
 Eastern Bakeries Limited
 McGavin Foods Limited

Biscuit Manufacturers

Christie Brown & Company Ltd.
 Colonial Cookies Ltd.
 Aliments Culinair Inc.
 Interbake Foods Limited
 Manning Biscuits Ltd.
 Windsor Wafers Inc.

Breweries

Carling O'Keefe Breweries
 of Canada Ltd.
 Labatt Breweries of Canada Limited
 Molson Breweries of
 Canada Limited
 Moosehead Breweries Limited
 Northern Breweries Ltd.
 Pacific Western Brewing Co. Ltd.

Confectionery Manufacturers

Adams Brands Inc.
Donini Chocolate Ltd.
Hanong Brothers Ltd.
Hershey Canada (Montréal) Inc.
Herr Bros. Limited
Leaf Confections Ltd.
Pee-Chee Company Ltd.
Powntree Mackintosh Canada Ltd.
Rebor Canada Inc.
William Neilson Ltd.
Wrigley Canada Inc.

Distilleries

Alberta Distillers Limited
Canadian Mist Distillers Limited
BM Distillery Co. Limited
Clbey Canada Inc.
Gram Walker & Sons Limited
Goderham & Worts Limited
Joseph E. Seagram & Sons, Limited
Queurs Saguenay Ltée
Fliser Distillers Limited

Food Processors

Campbell Soup Company Ltd.
E. Smith & Sons Limited
Funt-Wesson Canada Ltd.
Heinz Company of Canada Ltd.
Harrison Lamothe Inc.
Produce Processors Limited
Royal City Foods Ltd.
Sowcrest Packers Ltd.
Sn-Brite Canning Ltd.
Sn-Rype Products Ltd.
Thomas Canning (Maidstone) Ltd.

Fisheries

British Columbia Packers Limited
Blue Water Seafoods Limited
National Sea Products Limited

Dairy Products Manufacturers

Coopur Cooperative Ltée
Campbell Soup Company Ltd.
Canadian Home Products Ltd.
Celli Inc.
Cinar Inc.
General Foods Ltd.
Hobbs Suchard Canada Inc.
Hart Ltd.
Macia Bravo Foods Limited
March Fine Foods Ltd.
Maison Brands Ltd.
Maison (Canned Goods) Ltd.
Maison Food Services
National City Foods Ltd.
Thomas J. Lipton Inc.

Meat Processors

Canada Packers Inc.
F. W. Fearman Company Ltd.
Intercontinental Packers Ltd.
J. M. Schneider Inc.
Piller Sausages & Delicatessen Ltd.
Quality Meat Packers Ltd.
Unox, Division of
Thomas J. Lipton Inc.
Vancouver Fancy Meats Co. Ltd.

Poultry and Egg Processors

A.C.A. Co-operative
Association Ltd.
Bexel, Division of Co-op.
Fédération de Québec
Canada Packers Inc.
Co-op Dorchester Ltée
Export Packers Company Ltd.
La Poulette Grise Inc.
Lashbrook Produce Limited
Lilydale Co-op Limited
Lilydale Poultry Sales (Victoria) Ltd.
Lucerne Foods Ltd.
Maple Leaf Mills Limited
Maple Lynn Foods Ltd.
Pembina Poultry Packers Ltd.
P & H Foods Ltd.

Soft Drink Manufacturers

Amalgamated Beverages Ltd.
Beverage Services Ltd.
Binet et Turgeon Ltée
Brevages Drummond Ltée
Brevages Radnor Ltée
Canada Dry Bottling Co. Ltd.
Goodwill Bottling Ltd. (Victoria)
Goodwill Bottling Ltd. (Nanaimo)
Goodwill Bottling Ltd.
(Campbell River)
Goodwill Bottling Ltd.
(Prince George)
Goodwill Bottling Ltd.
(Prince Rupert)
Goodwill Bottling Ltd. (Terrace)
Goodwill Bottling Ltd. (Smithers)
Gray Beverage Inc.
Ideal Sport Inc.
Les Brevages Déraspé Ltée
Maedel's Beverages Ltd.
Maritime Beverages Ltd.
Pathfinder Beverages Ltd.
Pepsi Cola Canada Ltd.
Philippe Simard & Fils Ltée
Provincial Beverages Ltd.
Roux & Bergeron Ltée
S. Désormeaux Inc.
Seven-Up Valleyfield Ltée
Swift Current Bottlers Ltd.
T.C.C. Bottling (Calgary) Ltd.

T.C.C. Bottling (Cornwall) Ltd.
T.C.C. Bottling (Chicoutimi) Ltd.
T.C.C. Bottling (Chilliwack) Ltd.
T.C.C. Bottling (Coquitlam) Ltd.
T.C.C. Bottling (Drummondville)
T.C.C. Bottling (Edmonton) Ltd.
T.C.C. Bottling (Hamilton) Ltd.
T.C.C. Bottling (Granby) Ltd.
T.C.C. Bottling (Kamloops) Ltd.
T.C.C. Bottling (Kitchener) Ltd.
T.C.C. Bottling (Kingston) Ltd.
T.C.C. Bottling (London) Ltd.
T.C.C. Bottling (Quebec City) Ltd.
T.C.C. Bottling (North Bay) Ltd.
T.C.C. Bottling (Renfrew) Ltd.
T.C.C. Bottling (Richmond B.C.) Ltd.
T.C.C. Bottling (Sault St. Marie) Ltd.
T.C.C. Bottling (St-Paul) Ltd.
T.C.C. Bottling (St. John's) Ltd.
T.C.C. Bottling (Sherbrooke) Ltd.
T.C.C. Bottling (Sudbury) Ltd.
T.C.C. Bottling (Toronto) Ltd.
T.C.C. Bottling (Trois Rivières) Ltd.
T.C.C. Bottling (Uxbridge) Ltd.
T.C.C. Bottling (Vernon) Ltd.
T.C.C. Bottling (Weston) Ltd.

Starch Manufacturers

Casco Limited
Nacan Products Ltd.
Ogilvie Mills Ltd.
St. Lawrence Starch Co. Ltd.

Sugar Refineries

Atlantic Sugar Limited
British Columbia Sugar Refining
Company Limited
Lantic Sugar Limited
St. Lawrence Sugar Division
Natalik Inc.
Redpath Sugars Limited
Westcane Sugar Limited

Wineries

André's Wines Ltd.
Inniskillin Wines Inc.
Les Vins La Salle Inc.

General Manufacturing

Rubber Products

Gates Canada Limited
General Tire Ltd.
Michelin Tires (Canada) Ltd.
Trent Rubber Services Limited
Uniroyal-Goodrich Canada Ltd.

Chemical, Pharmaceutical and Medical Products

Canadian Occidental
Petroleum Limited
Diversey Wyandotte Inc.
E. F. Houghton Canada Inc.
Tambrands Canada Inc.
Valspar Chemicals Ltd.

Foundries, Forgings and Heavy Metal Processors

Aciers Slater Inc.
Ancast Industries Ltd.
Bibby-Ste-Croix Foundries Ltd.
Bowmanville Foundry Co. Ltd.
Brass Craft Canada Ltd.
Canada Forgings Inc.
Canadian Blower/Canada
Pumps Ltd.
Canadian Bronze Company Limited
Canada Ingot Mould Inc.
Canron Inc.
Canvil Ltd.
Esco Ltd.
Fahramet, Indusmin, Div. of
Falconbridge
Fondries Magotteaux Canada Ltée
Gray Forgings & Stampings Limited
Hawker Siddeley Canada Inc.
Huron Steel Products Limited
Lake Ontario Steel Company
Limited
Manville Canada Inc.
Metals & Alloys Company Limited
Reynolds Aluminum Company
Limited
The Canada Metal Company Limited
Western Foundry Co. Ltd.

Light Manufacturing

Atco Limited
Black and Decker Canada Inc.
Bombardier Inc.
Commercial Aluminum, a Div. of
Indal Ltd.
Dorr-Oliver Canada Limited
Dominion Controls Co. Ltd.
Eimco Jarvis Clarke Company
Limited
Fasco Products, Div. of Indal
Indal Technologies Inc.
Indalloy Ltd., Div. of Indal
Ivex Corporation
Kawneer Company of Canada
Limited
Kodak Canada Inc.
Paddle Valley Products Limited
Snap-On Tools Ltd.
Teledyne Canada Metal Products
Limited
Trane Canada Limited
Victory Soya Mills Ltd.

Industrial Minerals

Abrasives

Exolon - Esk Co. of Canada Ltd.
General Abrasives - Abrasives
Industries (Canada) Inc.
Norton Advanced Ceramics
of Canada Inc.
Washington Mills Electro
Minerals Corp.

Asbestos

Brinko Mining Ltd., Cassiar Division
Carey Canada Inc.
JM Asbestos Inc.
LAB Chrysotile (Bell) Inc.
LAB Chrysotile (Lac)
LAB Chrysotile
(BC/KB/Normandie) Inc.

Cement

Ciment Québec Incorporated
Federal White Cement Limited
Genstar Cement Limited
Lafarge Canada Inc.
Lake Ontario Cement Limited
Miron Inc.
St. Lawrence Cement Inc.
St. Mary's Cement Company

Clay Brick and Tile

Briqueterie St-Laurent Ltée
(Div of Jannock Ltée)
Canada Brick Company Limited
Canadian Vitrified Products Ltd.
Estevan Brick Ltd.
Hamilton Brick Ltd.
Medicine Hat Brick and Tile Ltd.
Medicine Hat Sewer Pipe Ltd.
NSP (Div of NSP Inc.)
Northwest Brick and Tile Ltd.
Redcliff Pressed Brick Ltd.
Red River Brick and Tile Ltd.
IXL Industries Ltd.

Concrete Products

Century Concrete Products Ltd.
Consolidated Concrete Products Ltd.
Doughty Concrete Products Ltd.
Downey Building Materials Ltd.
Genstar Materials Limited
Richvale Block & Ready-Mix
(Div of Lafarge Canada Inc.)
Redi-Mix Limited
York Block (Div. of Lafarge
Canada Inc.)

Glass

AFG Glass Inc.
Consumers Packaging Inc.
Domglas Inc.
Fiberglas Canada Inc.
Libbey St. Clair
PPG Canada Inc.

Lime

Beachville Lime Ltd.
Guelph DoLime Ltd.
Havelock Lime Company of
Canada Limited
Reiss Lime Company of
Canada Limited
Summit Lime Works Limited

Miscellaneous Minerals

Indusmin Limited
3M Canada Inc.
Saskatchewan Minerals Ltd.
Steetley Talc Inc.

Refractories

A. P. Green Refractories
(Canada) Limited
Canadian Refractories Limited
Clayburn Refractories Limited
Continental Refractories
Company Limited
General Refractories Co. of
Canada Ltd.

Machinery

ACCO Canadian Material Handling
a Division of Dominion Chain Inc.
Beloit Canada Ltée/Ltd.
Bingham International Inc.
Boart Canada Inc.
Canadian Blower/Canada Pumps
Limited
Canron Inc., Mechanical Division
Continental Conveyor & Machine
Works Ltd.
Continuous Mining Systems Limited
Crane Canada Inc., Valve &
Industrial Division
R.J. Cyr Co. Inc.
Dominion Engineering Works,
a Division of Canadian General
Electric Company Limited
Ebco Industries Ltd.
Edson Packaging Machinery Limited
FAG Bearings Ltd.
Farris Industries Canada
FMC of Canada Limited, Material
Handling Operation

Free Lightnin, Unit of General
Signal Limited
Leath & Sherwood (1964) Limited
Industries USP Inc.
Ingersoll-Rand Canada Inc.
J.G. Kalish Inc.
Lockums CanCar Inc.
Motivation Industrial
Equipment Ltd.
TD Products Ltd.
Mathex International Ltd.
Provincial Crane Inc.
MS Machinery Division, Uniroyal
Goodrich Canada Inc.
Smart Turner Limited
Union Pump (Canada) Ltd.
Hard Ironworks Limited
EMCO Canada, Division of Baker
International Canada Ltd.

Mining and Metallurgy

ECO Canadian Material Handling,
A Division of Babcock Ind.
Canada Inc.
VCO Conveying Systems
Bart Canada Inc.
Canadian Blower/Canada Pumps
Limited
Caron Inc.
Continuous Mining Systems Limited
Union Engineering Works Ltd.
Dresser Pump Division, Dresser
Canada Inc.
Dyne Limited
G Bearings Ltd.
Herman-Rupp of Canada Limited
Leath & Sherwood (1964) Limited
Mac Inc. Ltd.
Industries USP Inc.
Ingersoll-Rand Canada Inc.
Fluid Products Canada, Division
of ITT Industries of Canada Ltd.
Inc. Canada
J.G. Kalish Inc.
Langen & Sons Ltd.
A.N. Ashton Inc.
Lean Engineering &
Marketing Co. Ltd.
TD Products Ltd.
Master Winch Corporation
AS Machinery Division,
Uniroyal Goodrich Canada Inc.
Armstrong Limited
Aden Machine Limited
Smart Turner Limited
Ivan Strong Scott, Division of
Strong Equipment Corporation
Anet-Enerdry Inc.
Ed Ironworks Limited
Ester Air Equipment, Division of
Crittiss-Wright of Canada Inc.

Petroleum Refining

Consumers' Co-Operative
Refineries Limited
Esso Petroleum Canada
Husky Oil Products Company
Petro-Canada Products Inc.
Shell Canada Limited
Suncor Inc.
Syncrude
Texaco Canada Inc.
Turbo Resources Limited
Ultramar Canada Inc.

Plastics

Aclo Compounds Inc.
Acriform Engineering Ltd.
American Bilrite (Canada) Ltd.
Atlantic Packaging Products Ltd.
Beaver Plastics Limited
Bonar Plastics Ltd.
Burman-Castrol Canada Ltd.
Canada Cup Ltd.
Canadian General Tower Ltd.
Carlew Chemical Limited
Celfortec Inc.
Chantler and Chantler Inc.
Chemacryl Plastics Limited
Coastal Plastics Ltd.
Columbia Manufacturing
Company Ltd.
Daymond, Div. of Redpath
Industries Ltd.
Duron Plastics Ltd.
Emballage St-Jean Ltée
English Plastics Ltd.
F&H Plastics Ltd.
Ferro Industrial Products Ltd.
Fibracan, Div. of Innopac Inc.
Formica Canada Inc.
Gulf Plastics Ltd.
Hayden Manufacturing Co. Ltd.
Horizon Plastics Ltd.
IPL Ltd.
Jet Moulding Compounds Ltd.
Kyoda Plastics Limited
Les Systèmes Thermoplast Inc.
Monarch Plastics Ltd.
Morbern Inc.
Norseman Plastics Ltd.
Pavaco Plastics Inc.
Persita Inc.
Plastiques Anchor Ltée
Plasti-Drain Ltée
Plasti-Fab Ltd.
Plax Inc.
Polytainers Inc.
Propak Plastics Ltd.
Pro-Western Plastics Ltd.
Rubbermaid Canada Inc.

Scepter Manufacturing Co. Ltd.
Shaw Industries Ltd.
Schlegel Canada Inc.
Spartan Plastics Canada Inc.
Systèmes Thermoplast Ltée
Transco Plastic Industries Ltd.
Union Carbide Performance
Plastics Ltd.
Uniplast Industries Ltd.
Vanguard Plastics Ltd.

Pulp and Paper

Abitibi-Price Inc.
Armstrong World Industries Inc.
Atlantic Packaging Products Ltd.
Beaver Wood Fibre Co. Ltd.
Boise Cascade Canada Ltd.
Bowater Mersey Paper Company
Limited
Canadian Forest Products Ltd.
Canadian Pacific Forest Products
Limited
Cariboo Pulp & Paper Company
Cascades (Cabano) Inc.
Cascades (East Angus) Inc.
Cascades (Jonquière) Inc.
Celgar Pulp Company
Consolidated-Bathurst Inc.
Corner Brook Pulp & Paper Ltd.
Crestbrook Forest Industries Ltd.
Daishowa Inc.
Domtar Inc.
Donohue Inc.
Donohue Normick Inc.
Donohue St. Félicien Inc.
E.B. Eddy Forest Products Ltd.
Eurocan Pulp & Paper Co. Ltd.
F.F. Soucy, Inc.
Fletcher Challenge Canada Limited
J. Ford & Company Ltd.
Fraser Inc.
Gaspesia Pulp & Paper
Company Ltd.
Howe Sound Pulp and Paper
Limited
Irving Pulp & Paper, Limited
Irving Tissue Co.
Island Paper Mills Company
James River - Marathon, Ltd.
Kimberly-Clark of Canada Limited
Kruger Inc.
James MacLaren Industries Inc.
MacMillan Bloedel Limited
Malette Kraft Pulp &
Power Inc.
Manfor Limited
Minas Basin Pulp and Power
Company Limited
Miramichi Pulp and Paper Inc.
NBIP Forest Products Inc.

Northwood Pulp and Timber Limited
 Paperboard Industries Corporation
 Perkins Papers Ltd.
 Procter & Gamble Inc.
 Quebec and Ontario Paper Company Ltd.
 Rolland Inc.
 Rothesay Paper Limited
 St. Anne-Nackawic Pulp & Paper Company Ltd.
 St. Marys Paper Inc.
 Scott Maritimes Limited
 Scott Paper Limited
 Skeena Cellulose Inc.
 Sonoco Limited
 Spruce Falls Power and Paper Company, Limited
 Stora Forest Industries Limited
 Strathcona Paper Company
 Tembec Inc.
 Weldwood of Canada Limited
 Western Pulp Limited Partnership
 Weyerhaeuser Canada Ltd.

Canadian Textiles Institute

Albany International Canada Inc.
 Artex Woollens Limited
 Asten-Hill Inc.
 Badische Canada Ltd.
 Barrymore Carpet Inc.
 Bell Tootal Inc.
 Bermatex Inc.
 Britex Ltd.
 Burlington Canada Inc.
 Celanese Canada Inc.
 Cley & Tinker Inc.
 C&T Modele Inc.
 Coats, J. & P., (Canada) Inc.
 Consoltex Inc.
 Fashion Division –
 • Cowansville
 • Drummondville
 Home Furnishings Division –
 • Sherbrooke
 Outerwear Division –
 • Alexandria
 • Montmagny
 • Coaticook
 Crossley Karastan Carpet Mills Ltd.
 DeBall, J.L., Canada Limited
 Dominion Textile Inc.
 Apparel Fabrics –
 • Beauharnois Finishing Plant

- Domil, Sherbrooke
- Drummondville
- Long Sault, Fabrics
- Magog

Consumer Products –
 • Caldwell, Iroquois
 • Sherbrooke
 • Esmond, Granby
 • Magog

Sales Yarn –
 • Domil, Sherbrooke
 • Long Sault, Yarns
 • Mount Royal Dye House, Montreal

Industrial Products –
 • Drummondville
 • Yarmouth
 • Hawkesbury
 • Woodstock

Drytex, Division of JWI Ltd.
 Dura Undercushions Ltd.
 Les Tricots Duval & Raymond Ltée
 Harding Carpets Limited
 Harvey Woods Limited
 Heuga Canada Limited
 H.N. Biron & Fils Inc.
 Huyck Canada Limited
 Leedye Inc.
 Newlands Textiles Inc.
 Nova Scotia Textiles Ltd.
 Ozite Canada (1981) Inc.
 Patons & Baldwins Canada Inc.
 Peeters Carpets Ltd.
 Rayonese Textile Inc.
 Rubyco Inc.
 Rumpel Felt Company Limited
 Satexil Inc. Division Texgran
 Tapis Coronet Inc.
 Tapis Peerless Ltée
 Tapis Venture Canada Ltée
 Textiles Dionne Inc.
 • St. Georges de Beauce Division
 • Montmagny Division
 • Drummondville Division
 Tricots Canada U.S. Inc.
 Waterville Cellular Products Ltd.

Transportation (Mfg.)

Aerospace Industries Association of Canada

Aircraft Appliances and Equipment Limited
 Airtech Canada
 Bendix Avelox Inc.
 Boeing Canada – de Havilland Division

Bombardier Inc.
 Canadair Aeronautical & Defense Group
 CAE Electronics Ltd.
 Canadian Marconi Company
 Chicopee Manufacturing Limited
 Computing Devices Company
 Conair Aviation Ltd.
 Dew Engineering and Development Limited
 Field Aviation East Ltd.
 Garrett Canada
 Haley Industries Ltd.
 Heli-Fab Ltd.
 Howland Russell Consultants Ltd.
 Indal Technologies Inc.
 Litton Systems Canada Limited
 Lucas Industries Canada Limited
 McDonnell Douglas Canada Limited
 Pratt & Whitney Canada Inc.
 Raytheon Canada Limited
 Rockwell International of Canada Ltd.
 Rolls-Royce (Canada) Limitée
 Spar Aerospace Limited
 UDT Industries Inc.
 Unisys Canada Inc.
 Walbar Canada Inc.

Automotive Parts Manufacturers' Association

Accurcast
 Algoods, Division of Aluminum Company of Canada Ltd.
 Allied-Signal Automotive of Canada Inc. – Fram Canada Division
 Amcan Castings Limited
 Associated Spring – The Wallace Barnes Company Ltd.
 B & W Heat Treating (1975) Limited
 A. Berger Precision Ltd.
 Blackstone Industrial Products Limited
 Budd Canada Inc.
 Canada Forgings Inc., A Division of Toromont Industries Ltd.
 Champion Spark Plug Company Canada Inc.
 Collins & Aikman Inc.
 Court Industries Co. Ltd.
 Daymond, a Division of Redpath Industries Limited
 Degussa Canada Ltd.
 Dominion Controls Company
 Epton Industries Inc.
 Excel Metalcraft Ltd.
 FAG Bearings Ltd.
 Ferraloy, Pullman Canada Ltd.
 Gabriel of Canada Ltd.
 Galtaco Inc.
 Goodyear Canada Inc.
 Hayes-Dana Inc.

over Universal (Canada) Ltd.
 ull-Thomson Limited
 t Moulding Compounds Limited
 elsey-Hayes Canada Limited
 agran Canada Inc.
 (Burlington Canada Inc.)
 ear Siegler Seating Corp.
 lastico Industries Limited
 TD Products Ltd.
 he Narmco Group
 PG Canada Inc., Duplate Division
 ebra Inc.
 ecision Rubber Products (Canada)
 Ltd., a Wynn's International
 Subsidiary
 ynolds Aluminum Company of
 Canada Ltd.
 ockwell International Suspension
 Systems Company
 teller-Globe
 emens Bendix Automotive
 Electronics Limited
 enteris Inc.
 ater Steel Corporation
 andard Tube Canada Inc.
 emco Canada
 chform Products Limited
 homson (Canada) Rivet Co.
 Limited
 idon North America
 im Trends Canada Limited
 Alcro Canada Inc.
 ebster Manufacturing (London)
 Limited
 vesthead Industries

**Canadian Maritime
 Industries Association
 (Formerly Canadian Shipbuilding
 and Ship Repairing Association)**

Allied Shipbuilders Ltd.
 amond Canapower
 rine Industrie Limitée
 rystown Shipyard Ltd.
 VL Davie Inc.
 ptou Industries Limited
 Port Arthur Shipbuilding
 Sar Inc.
 Suriplex Systems Inc.

**Canadian Truck and
 Trailer Manufacturers'
 Association**

Cisco Ltd.
 Trailmobile Group of
 Companies Ltd.

**Allied Boating
 Association of Canada**

Lund-Larson Boats Canada Ltd.

**Motor Vehicle
 Manufacturers' Association**

Chrysler Canada Ltd.
 Ford Motor Company of Canada Ltd.
 General Motors of Canada Ltd.
 Navistar International Corporation
 Canada
 Volvo Canada Ltd.

Wood Products (Western)

Balfour Forest Products Inc.
 Canadian Forest Products Limited
 Evans Products Co. Ltd.
 Federated Co-Operatives Ltd.
 Finlay Forest Industries Ltd.
 Fletcher Challenge Canada Limited
 Gormon Bros. Lumber Ltd.
 Groot Lumber Ltd.
 International Forest Products
 MacMillan Bloedel Ltd.
 Nechako Lumber Co. Ltd.
 Northwood Pulp & Timber Ltd.
 The Pas Lumber Company Ltd.
 Quesnel Forest Products
 Riverside Forest Products Ltd.
 Rustad Bros. & Co. Ltd.
 Stuart Lake Lumber Co. Ltd.
 Weldwood of Canada Limited
 West Fraser Mills Ltd.
 Zeidler Forest Industries Ltd.

Appendix A

Reporting Methodology

The objective of the CIPEC monitoring system is to track as closely as possible the actual changes in production energy intensity. Performance monitoring procedures and accounting methodology used by the task forces followed a prescribed aggregating method established by CIPEC in 1975.

The basis of the CIPEC method is to compare energy consumption to physical units of production, where possible. This is done by determining the difference in current year consumption to the energy that would have been used in a base year (at the same level of production) before any efficiency improvements had taken effect.

The quantity of energy savings claimed is calculated as the difference between the total current year energy consumption and the base year equivalent energy consumption. Each year the base year equivalent energy consumption is determined by aggregating the results of each participating company. This method of determining changes in energy-intensities thus incorporates the total effects of changes in production-mix, production volumes, technologies, and energy conservation activities.

Similarly, energy cost savings is the difference between what would have been spent on energy (if there had been no efficiency improvement) and the current energy expense. The figure fluctuates because of the voluntary nature of participation in the program; estimates of energy savings depend on the quantity of energy reported by the CIPEC participating companies and total efficiency improvement in that particular year.

Feedstocks used in the chemical and petroleum refining industries are not included in the task force or CIPEC accounting system since conservation of these commodities is not an issue. However, process improvements which register as site throughput reductions are regarded as conservation of energy. In the ferrous metal industry, the metallurgical coal that is used to make coke for steel manufacture is treated as a primary fuel input.

Since reporting began, it has been necessary to apply minor adjustments to the consumption numbers to normalize the impact of fluctuations in weather, added energy consumption from imposed environmental equipment and periodic changes in raw material quality. These corrections are done at the individual company level which often report both gross and net efficiencies. This practice will be continued to allow participants to make future adjustments where necessary.

After more than a decade of CIPEC monitoring most task forces update individual reference years to 1990 to recognize the many fundamental changes that have occurred since the beginning of the program. Reporting of future performances will carry forth the past achievements, however, to retain the long term trend in performance.

ppendix B

Prefix	Multiple	Symbol
kilo	10^3	k
mega	10^6	M
giga	10^9	G
tera	10^{12}	T
peta	10^{15}	P
exa	10^{18}	E

Energy	Metric	Imperial
Electricity – net	0.003.6 MJ/kWh	3413 BTU/kWh
– gross	0.010551 MJ/kWh	10000 BTU/kWh
Natural Gas	0.0372 MJ/m ³	1.0×10^6 BTU/MCF
Propane	0.0266 MJ/litre	0.1145×10^6 BTU/IG
Crude Oil (#6)	0.0385 MJ/litre	5.8×10^6 BTU/bbl
Distillate Oil (#2)	0.039 MJ/litre	0.168×10^6 BTU/IG
Residual Oil (#5)	0.0423 MJ/litre	0.182×10^6 BTU/IG
Coal – Bituminous	32.1 GJ/tonne	27.6×10^6 BTU/ton
– Subbituminous	22.1 GJ/tonne	19.0×10^6 BTU/ton
– Metallurgical	29.0 GJ/tonne	25.0×10^6 BTU/ton
Coke – Petroleum (Raw)	23.3 GJ/tonne	20.0×10^6 BTU/ton
Gasoline	0.0362 MJ/litre	0.156×10^6 BTU/IG
Diesel Fuel	0.0399 MJ/litre	0.172×10^6 BTU/IG
Kerosene	0.0388 MJ/litre	0.167×10^6 BTU/IG
Liquid Propane Gas (LPG)	0.0271 MJ/litre	0.117×10^6 BTU/IG

To Convert from	to	Multiply by
Cubic Feet	Cubic Metres	0.028
Cubic Feet	Gallons (Imperial)	6.229
Cubic Feet	Litres	28.316
Barrel (Oil)	Cubic Metres	0.159
Barrel (Oil)	Gallons (Imperial)	34.973
Gallon (Imperial)	Litres	4.546
Gallon (U.S.)	Gallons (Imperial)	0.8327
Short ton	Pounds	2000
Short ton	Tonnes	0.9072
Tonne	Short tons	1.102
Long ton	Pounds	2240
Long ton	Tonnes	1.016
Kilogram	Pounds	2.205
BTU	Joules	1055.1
Kilojoule	BTU	0.948
Gigajoule	Barrels Oil Equiv.	0.164

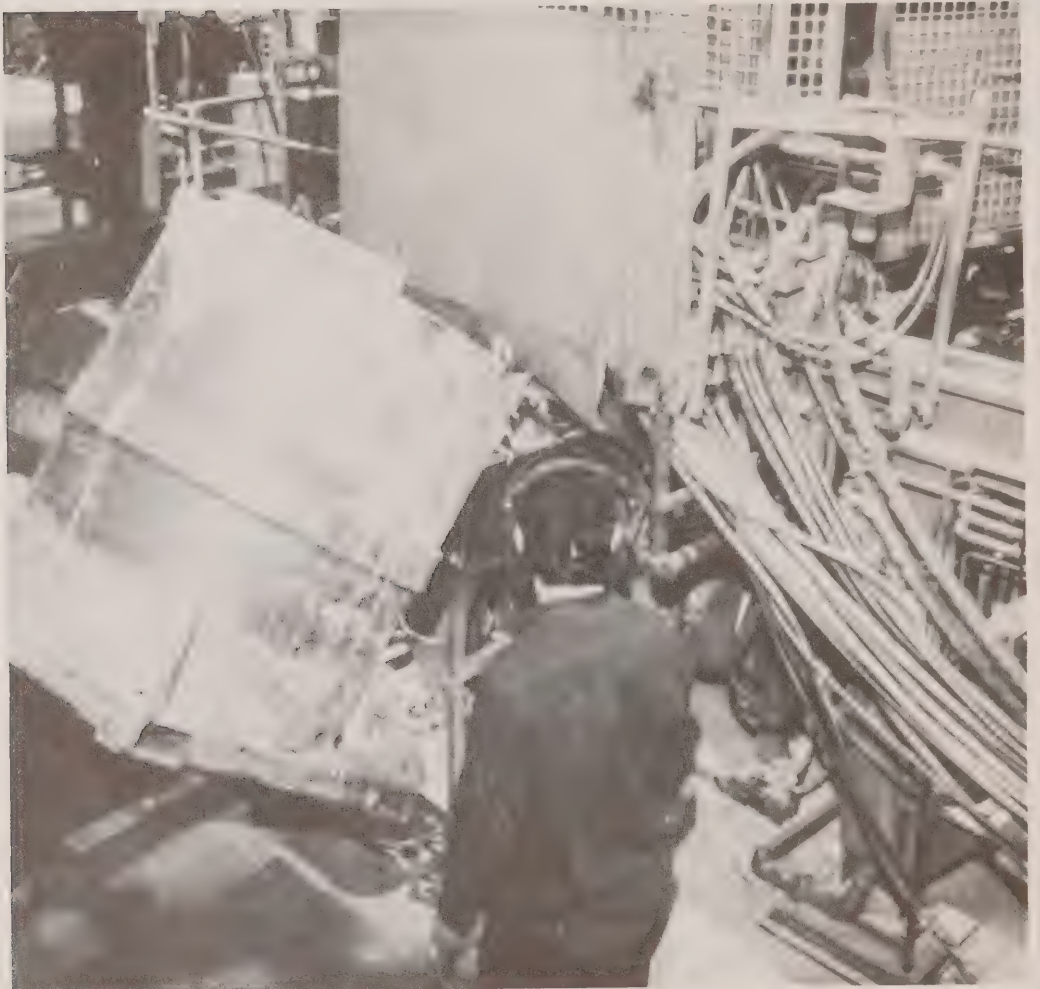


Photo -- Foundry Operation
Volkswagen of Canada Ltd.

he information, perspectives and
ata reported herein are solely the
esponsibility of the Canadian
dustry Program for Energy Conser-
ation Council and the reporting
sk forces.

he co-operation and support of
nergy, Mines and Resources
Canada, in the preparation of this
port is appreciated.



Energy, Mines and
Resources Canada

Énergie, Mines et
Ressources Canada



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Canadian Industry Program for Energy Conservation



1989

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Transportation

Ken Rossi
Manager - Plant Engineering Staff
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Oakville, Ontario
L6J 5E4

Wood Products (Western)

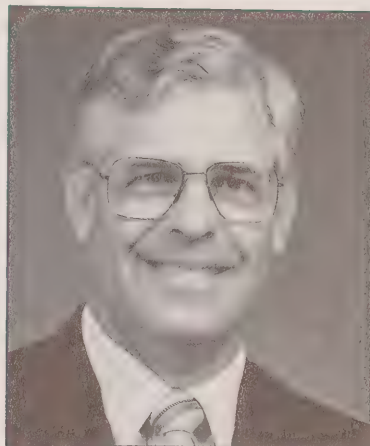
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CANADIAN
INDUSTRY PROGRAM
FOR ENERGY CONSERVATION

PROGRAMME CANADIEN
D'ÉCONOMIE D'ÉNERGIE
INDUSTRIELLE

October 31, 1990

The Honourable Jake Epp, P.C., M.P.
Minister of Energy, Mines and Resources
House of Commons
Ottawa, Ontario
K1A 0A6



Dear Minister,

The 1989 energy performance of CIPEC reporting companies reflects the 1985-1989 "energy environment" of soft prices, unfocused energy management effort and an emphasis on other business issues. It does not reflect energy price fluctuations resulting from the current Middle East situation. Nor does it reflect the growing recognition by industry that more effective energy use is a necessary component of the effort required to protect the environment.

Industry's energy use per unit of output for 1989 remained at the same level as 1988 – 28.8% less than the base year of 1973 and 4.8% less than 1985. Given the current economic and business climate, it will be a great challenge to achieve our 1990 goal established five years ago of a 31% improvement over 1973 energy intensity levels.

We are now at the point where new industrial energy reduction targets must be established. The pace of industrial globalization, the restructuring of our economy and its relative competitiveness, the impact of provincial and local utility efforts at energy conservation, coupled with the environmental imperative, will all have to be factored into this target setting process. The Energy, Mines and Resources discussion paper "Energy Use and Atmospheric Change" tables several proposals, including the formation of a Minister's National Advisory Council, that will help address this issue.

These targets and their achievement will provide the industrial sector contribution to the environmental objectives as they did for the energy efficiency objectives of the 1970's and 1980's.

As the CIPEC program begins a new decade, it is imperative that both industry and government reassess their commitment to this effort and work together to establish and move forward with initiatives which will stand the test of the 1990's. The CIPEC council looks forward to participating in this building process.

Sincerely,

A handwritten signature in dark ink, reading "W.P. Torbet". The signature is written in a cursive, flowing style.

W.P. Torbet
Chairman, CIPEC Council

The Canadian Industry Program for Energy Conservation (CIPEC) is an industry-administered/government-sponsored program for promoting and monitoring energy efficiency throughout the Canadian manufacturing and mining industries.

CIPEC was established on May 23, 1975, as a result of deliberations between the Federal Government Ministers of Energy, Mines and Resources and Trade and Commerce, and 50 of industry's most senior representatives. It now consists of 14 different industrial task forces that represent a broad spectrum of Canadian manufacturing and mining industries.

The program's objectives in promoting energy conservation are to:

- Promote energy productivity improvement in Canadian industry;
- Maintain an effective forum for industry/government dialogue on energy utilization and productivity matters;
- Forecast aggregate energy productivity improvement based on Canadian industry programs;
- Collect data and report on energy productivity of Canadian industry.

Table of Contents

Direction of Energy Conservation

1989 Performance	1
Energy Consumption and Trends	1
Electricity	1
Natural Gas	3
Petroleum Products	3
Coal and Coke	4
Other Fuels	4
1989 Business Conditions	4
Initiatives for Energy Conservation	6
Energy and the Environment	6
Potential Annual Energy Savings	7
Spending on Energy Efficiency RD&D	8
Status of Energy Conservation	8
Demand Side Management Programs	9

Task Force Reports

Chemical	12
Electrical and Electronic	15
Ferrous Metals	18
Food and Beverage	21
General Manufacturing	27
Industrial Minerals	31
Machinery	36
Mining and Metallurgy	38
Petroleum Refining	42
Plastics Processing	45
Pulp and Paper	48
Textiles	50
Transportation (Manufacturing)	53
Wood Products (Western)	56

Reporting Companies	59
----------------------------------	----

Appendix A – Reporting

Methodology	64
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Appendix B – Conversion Factors	65
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Direction of Energy Conservation

1989 PERFORMANCE

Industry's energy use efficiency, covering 72% of the total consumption in the manufacturing and mining sectors, remained at the same level as 1988.

Overall performance has improved 28.8% relative to the consolidated 1973 reference year values, but only 4.8% since the updated 1985 base year levels.

This performance is the result of an annual survey of 629 participating companies in 14 different industrial sectors. CIPEC energy-use efficiency is measured by consolidating changes in each company's energy intensity levels (energy-use per unit of production).

The individual performance of the participating industry task forces is displayed in Figure 2 together with their respective 1990 performance goals.

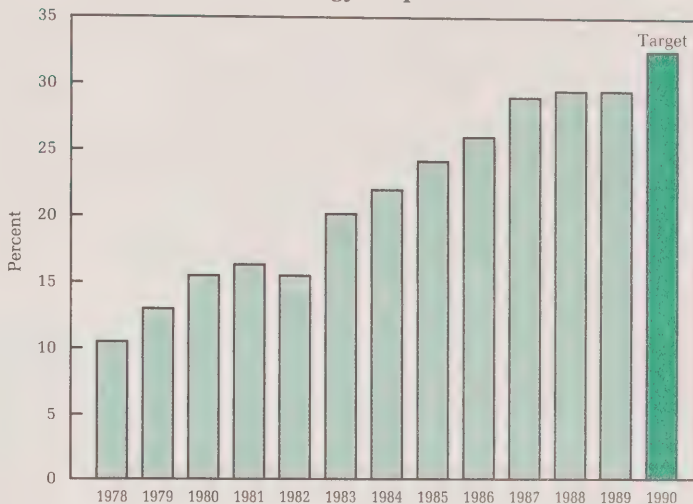
The flat performance is the result of flowing production output, lower capacity utilizations, less than adequate investment in energy improving retrofits, and a focus on other business issues.

Energy Consumption and Trends

Reporting companies used 1,616 petajoules (PJ) of energy in 1989, which was about 72% of the total

Figure 1

CIPEC Energy Improvement



2,154 PJ used by all industry. CIPEC energy consumption is equivalent to nearly 267 million barrels of crude oil. By comparison, a city the size of Toronto uses one PJ of energy for all purposes including heating, lighting, transportation, etc., every 15 hours.

The total Canadian net domestic use amounted to about 7,673 PJ, of which industry used 25.8%, transportation 23.5%, residential and farms 21%, and government and commercial users 13%. Producers and transporters of energy used 920 PJ of energy themselves.

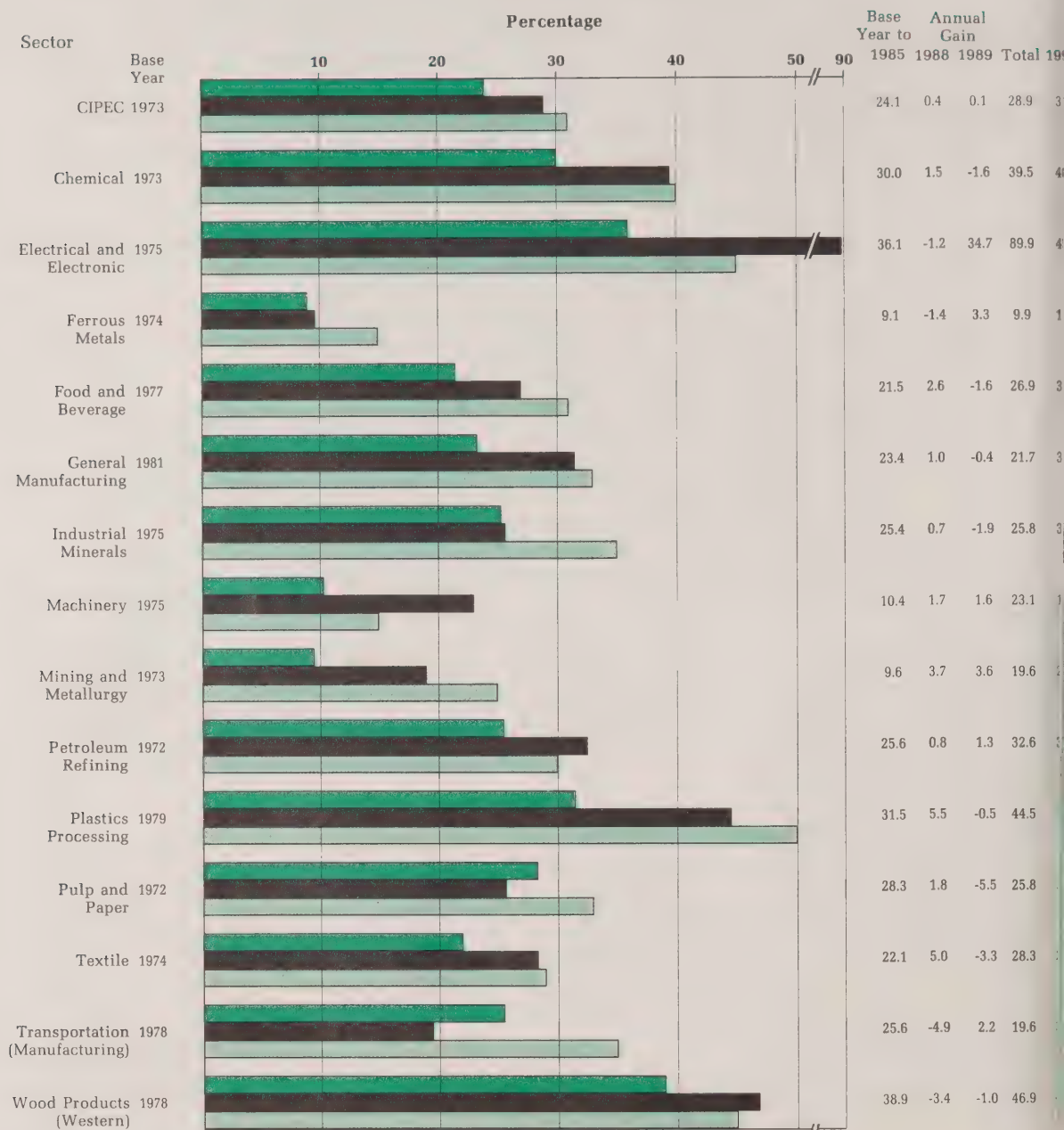
Electricity

CIPEC participants' demand for electricity in 1989 was 9,432 MW. Canada's total net generating capacity was approximately 98,000 MW during the year.

Demand for electricity in the surveyed companies continues to grow by about 1.6% per year because of the continuing trend in automation, greater use of electrical heating, etc. It is estimated that electricity provides 18.4% of the total power, but accounts for 50.7% of the total expense. For all of domestic industry the electricity share is 23.1%, which reflects a broader mix of smaller and more diversified operations.

Figure 2

ENERGY INTENSITY IMPROVEMENT



Legend: ■ - 1985 Total Improvement
■ - 1989 Total Improvement
■ - 1990 Goal

Source: CIPEC Task Force Reports

In Quebec companies, especially in the pulp and paper industry, there was a noticeable shift away from electricity because of the directed shutdown of electric powered steam boilers.

Natural Gas

Approximately 15.1 billion cubic metres of natural gas was used for process heating, steam generation, VAC, and other purposes such as feedstocks in 1989. The CIPEC efficiency monitoring accounts only for on-feedstock use. Total domestic consumption of gas amounted to 9.8 billion cubic metres and 37.9 billion cubic metres was exported, according to National Energy Board (NEB) statistics.

The natural gas share, now at 4.8% in the CIPEC surveyed companies, has also gradually increased about 1.6% per year. This is some-

what higher than the 30.6% overall industrial use because of the difference in the reporting population. For the CIPEC group, it is estimated the gas cost \$2 billion, which amounted to about 27.3% of the total energy expense.

As a result of the deregulation following the 1985 Agreement on Natural Gas Markets and Prices, it is estimated that about 25% of national sales are now direct from the producer to the end-user (no direct sales are permitted to commercial or residential users consuming less than 35,000 gigajoules per year at one location).

Petroleum Products

A total of 4.836 million cubic metres (30.4 million barrels) of light and heavy fuel oil and diesel fuel were used by the surveyed companies in 1989. In addition, 418,335 cubic metres of gasoline, propane and

LPGs were consumed. Crude oil production in Canada (including conventional light and heavy crude oil, pentanes plus and synthetic crude oil) averaged approximately 265,000 cubic metres per day. At this rate, CIPEC recorded use amounts to only 18 days of total production.

The NEB's estimate of remaining established reserves of conventional crude oil, as of December 31, 1988, is 666.2 million cubic metres, or about 7 years' supply at the current rate of consumption.

CIPEC participants' share of total energy use has dropped from 32% in 1975 to 13% in 1989. Residual oil is still a major fuel component in the pulp and paper and textile industries in the province of Quebec. The combined cost is estimated at some \$800 million for fuel oil, gasoline, diesel and LPGs.

Table I

Distribution of Energy Consumption (percentage)

	Electricity ¹			Natural Gas			Liquid Pet. Prod.			Coal & Coke			Others ⁽²⁾		
	'89	'85	'75	'89	'85	'75	'89	'85	'75	'89	'85	'75	'89	'85	'75
Chemicals	11.2	27.9	17.3	62.3	51.2	57.1	5.6	4.3	24.3	0.4	0.1	—	18.1	16.5	1.3
Electrical & Elect.	35.1	33.5	27.8	54.6	63.6	48.0	8.5	1.4	24.4	—	—	—	—	1.5	0.2
Ferrous Metals	6.8	7.3	5.4	17.0	19.4	15.4	7.9	4.2	13.2	68.3	69.1	68.6	—	—	0.3
Food & Beverage	21.9	18.6	12.8	63.6	69.7	48.5	14.2	11.7	38.5	—	—	—	—	—	0.2
General Mfg.	33.7	28.1	n/a	50.8	60.2	n/a	9.1	11.6	n/a	—	—	—	6.2	0.1	n/a
Industrial Minerals	18.8	15.6	10.3	38.7	42.6	50.6	7.1	8.7	33.1	34.5	32.4	5.8	0.9	0.7	0.1
Machinery	33.9	37.4	23.6	62.5	54.1	22.1	3.4	8.5	51.4	—	—	—	0.1	—	—
Mining & Metallurgy	25.8	41.2	35.1	33.2	25.2	12.4	13.2	23.5	48.0	7.5	9.9	4.4	—	0.2	—
Petroleum Refining	5.3	4.6	3.5	15.8	24.3	12.5	9.0	6.7	22.9	21.6	19.6	16.7	48.1	44.7	44.4
Plastics Processing	46.1	43.2	23.7	47.2	51.4	43.5	4.9	5.4	31.9	—	—	—	—	—	—
Pulp & Paper	36.7	44.9	24.9	29.5	26.1	18.3	31.7	25.8	52.7	1.2	2.9	3.6	0.9	0.3	0.3
Textiles	27.1	29.1	20.1	61.7	55.0	29.1	11.3	15.8	49.9	—	—	—	0.2	0.1	0.9
Transportation (Mfg.)	28.2	30.1	23.0	60.4	55.2	42.1	—	3.7	31.0	7.4	11.0	3.1	0.2	0.6	0.4
Wood Products	54.2	48.0	n/a	45.8	52.0	n/a	—	—	n/a	—	—	—	—	—	—
Totals	18.4	19.1	14.6	34.8	32.3	27.9	13.1	17.6	32.0	18.3	19.2	17.8	12.6	11.8	7.7

Footnotes:

(1) All sectors' electricity converted at 3,600 kilojoules/kWh.

(2) Other fuels include purchased steam, plant wastes, process by-products, miscellaneous fuels, but excludes wood wastes used in the Pulp and Paper and Wood Products sectors.

Source: CIPEC task force reports.

Coal and Coke

About 9.2 million tonnes of coal and coke were used in CIPEC companies during 1989. Domestic demand for coal increased by 8.5%, from 50.1 megatonnes to 54.4 megatonnes, due again to higher rates of thermal electricity generation; hydro generation is suffering from low precipitation rates and low reservoir levels.

Coal is used primarily in Ontario by utilities and in the steel and cement manufacturing industries. The cement manufacturing sector continues to use large quantities of coal, but has in some instances switched to lower priced natural gas. The largest cement manufacturer is continuing its investigation into cheaper sources such as municipal refuse.

Lime injection scrubbing systems, slagging combustors, irradiation cleanup methods and fluidized bed combustion systems are all technologies which can contribute to lower sulphur dioxide emissions in coal-burning processes. Unfortunately, these environmental safeguards often result in increased

energy consumption which impact on the economics of retrofit projects.

Other Fuels

The "other" category includes a diverse mix of wastes, process by-products and miscellaneous fuels used mainly by the chemical and petroleum refining industries. The significant amount of hog-fuel and pulping liquor used in the pulp and paper industry, as well as large quantities of hog-fuel used in the wood products industry, are not included in this category because of the difficulty in measuring heat content and quantities.

Occasionally the use of these "wastes" changes when their resale value exceeds their replacement fuel value. A recent example is the increased sale of by-product hydrogen.

Since many of these fuels are generally free sources of energy, industry has fully utilized this option. Constraints on greater use of waste fuels are the availability of steady supplies and technological problems associated with materials handling and combustion.

1989 Business Conditions

Some key business indicators fundamentally affecting energy utilization are shown in Table II. While GDP rose in 10 sectors and dropped in 4, the momentum for spending on new equipment was mixed, but capacity utilization slipped in 8 industries while gaining in only 6. Usually there is more consistency in the energy-use efficiency related trend.

Another signal of changing business conditions was the growing number of companies that participated in previous CIPEC surveys but now only import products for resale. This is happening more frequently with multi-national low-energy intensive, high-wage operations. In a few instances the disruption caused by mergers and acquisitions also prevented routine reporting this year.

Capital Investments

Statistics Canada estimates that over 1% of all annual capital investment

¹ Analysis of the Categories of Capital Investment, J. Lacroix, Nov. 1989

Table II

Key Sectoral Business Factors

Sector	GDP		Capacity		Investment	
	\$, MM	Chg.	%	Chg.	\$, MM	Chg.
Chemicals	7,732	0.7	92.5	0.1	2,258	20.8
Electrical & Electronic	15,275	10.0	99.9	2.4	780	-1.6
Ferrous Metals	8,766	-1.1	90.6	-4.4	3,951	20.4
Food & Beverages	10,218	1.1	77.4	-1.6	2,110	7.9
Industrial Minerals	3,293	0.7	71.7	2.1	822	5.6
Machinery	3,293	0.7	68.4	-8.7	572	6.1
Mining & Metallurgy	11,651	—	69.3	-3.4	4,504	-4.3
Petroleum Refining	1,165	3.0	76.1	2.0	1,272	18.8
Plastics Processing	1,946	—	79.7	-7.2	n/a	—
Paper Industries	9,323	—	84.8	-3.8	7,005	29.1
Textiles	2,951	—	91.1	-6.2	383	-14.8
Transportation (Manufacturing)	13,664	-1.3	64.8	-7.0	3,206	-11.0
Wood Products (Western)	3,953	-1.3	80.7	-5.9	1,053	-13.0
Durable Goods	62,095	2.6	79.0	-3.1	—	—
Non-Durable Goods	46,391	1.0	81.8	-1.7	—	—
Total Manufacturing	110,574	1.9	80.3	-2.4	28,463	10.9

Canadian industry is spent to reduce energy costs. In a survey¹ of spending patterns between 1985 and 1987, about 53% was directed into capacity expansion, 40% for equipment replacement and modernization, 1% for pollution abatement and control, 1% for improvement in working conditions and 4% for other reasons. However, some of the 40% spending on modernization would certainly augment the 1% specifically identified for energy retrofits.

Weather

Industry's energy-use has also been affected by the weather, which has changed significantly over the past decade. Although annual conditions have varied considerably, average temperatures were generally warmer and most of Canada had less snowfall. This evidence comes as we close the decade during which the "greenhouse effect" became a household word. The greatest departure from normal occurred in the Prairies, with up to a 1.4 C° increase above usual conditions. The Maritimes are the only area with slightly cooler temperatures.

The effects of temperature increases have also been significant in other ways. In addition to more frequent forest fires, there was much less rain fall, which reduced hydraulic generating capacities significantly. In Quebec, electricity programs had to be curtailed and electric powered steam boilers taken out of service. More power had to be

generated with fossil and nuclear fuels. According to Environment Canada snowfall decreased 10% in Canada over the past decade.

In 1989, seasonal total heating energy requirements were 89% of normal in British Columbia, 91-113% across the Prairies (west to east), 119% in southern Ontario, 121% in southern Quebec and the Maritimes and 104% in Newfoundland.

In the record breaking month of December, heating requirements were 18% higher than normal in Winnipeg, 31% higher in Toronto, 35% higher in Montreal and 32% higher in the Maritimes. General manufacturing operations thus used significantly more energy, which did not help their operating efficiency.

Energy Prices and Costs

It is estimated that CIPEC participating companies spent about \$9.2 billion for fuel and electricity during 1989. This would have been \$4 billion higher if there had been no efficiency improvements, energy conservation, changes in product designs and energy price reductions brought on by deregulation and self-generation, etc.

The value of primary energy production in 1989 (Cansim #EET8CCA) amounted to \$39,459 million, of which the total manufacturing and mining industries spent

Table IV
Average Sector Energy Costs
\$ per Gigajoule

Chemicals	4.00
Electrical	6.81
Ferrous Metals	3.05
Food & Bev.	7.07
General Mfg.	6.27
Ind. Minerals	4.90
Machinery	6.77
Mining	6.24
Pet. Refining	1.96
Plastics Proc.	7.79
Pulp & Paper	6.57
Textiles	5.92
Trans. Mfg.	6.01
Wood Prod.	8.39
CIPEC Average	4.53

some \$12,903 million (32.7%). CIPEC participants accounted for about 72% of the total industrial energy expense.

Average energy prices vary considerably throughout the provinces, as shown in Table III, because of the abundance of indigenous resources and local pricing policies.

The resulting aggregate energy cost for each of the different sectors is shown in Table IV. Sector costs vary because of the different share of energy, use of wastes, locations and type of contract rate structures. Thus the stimulus for energy conservation in the participating sectors shows considerable variation.

Table III

1989 National Average Industrial Energy Prices \$/GJ

	Nfld.	PEI	N.S.	N.B.	Que	Ont	Man	Sask	Alb	B.C.	Canada
Elect.	15.60	16.27	13.30	11.78	9.16	12.70	8.61	10.66	9.00	8.85	12.72
Oil	7.90	7.51	6.97	8.00	7.46	8.02	8.17	3.66	—	7.87	7.71
N.G.	—	—	—	—	4.80	4.27	3.66	3.75	1.87	3.31	3.37

Source: EMR Handbook

1. Electricity – Industrial monthly consumption of 3,100,000 kWh
2. Fuel Oil – Retail domestic prices
3. Natural Gas – total sales. Average price for large companies is \$2.45/GJ (\$0.091/m³)

Initiatives for Energy Conservation

Overview

The neutral performance in 1989 is one more indication that business is slipping into a recession similar to the one that occurred in 1981-1982. At that time energy-use efficiency, which had advanced at about 2% per year, slowed to a 1% gain in 1981 and lost 1% in 1982. Then, a resurgence of productivity enhancements, business rationalizations, tighter budgets, leaner organizations, etc., together with steadily improving business conditions, restored the energy efficiency gains to 2% per year until 1989.

Between the 1983 and 1988 growth years, energy efficiency was closely linked with general improvements in production output, gradual rise in capacity utilization and general increases of investment in new equipment and innovative technologies. All through this period there were underlying unmeasurable benefits occurring from the changing mix and redesign of many of industry's products. For example, while no definitive study has been done on the Canadian situation, the United States Department of Energy estimates⁴ that 18% of the U.S. national reduction in energy use comes from an industrial-mix shift factor while 20% is due to more efficient manufacturing techniques. A similar pattern is thought to exist in Canada.

In recent years new significant factors have emerged in the industrialized world that will have a major impact on energy use and future efficiency. Unquestionably, the most important is a genuine concern for protection of the environment. The shape and pace of globalization is quickening with the emergence of larger and stronger trading blocks. Each country is having to restructure to be able to offer special economic and energy related strengths to suit the requirements of these new trading associations.

As well, governments of indus-

trialized nations are also having to cope with soaring deficits and are now struggling to redefine their future energy policies including the extent of intervention in their countries' energy affairs. Nearly all member countries in the OECD International Energy Agency (IEA), of which Canada is a member, are beginning to formulate new national energy policies and strategies to place more emphasis on energy conservation. In all OECD countries, energy conservation is seen as the cornerstone of environmental improvement. Many countries also see energy conservation as the least-cost means of righting the balance between supply and end-use, not only for national security reasons, but also as a way to avoid the huge costs in subsidizing unnecessary "megaprojects".

In Canada in the past few years, one of the strongest motivating factors for energy conservation – price – has been soft. This has been primarily because of self-sufficiency, market deregulation and the workings of free-market forces. In 1988, for example, real costs of energy⁵ to Canadian industry dropped 0.9% (oil products went down 2.0%, electricity increased 15.7%, natural gas dropped 15.0% and coal went down 8.2%). In other OECD countries, the composite price dropped 3.4% in the United States and 1.7% in Japan, but went up 1.3% in Germany, 5.4% in Italy, 10.6% in Sweden, 14.6% in Belgium and a jolting 34.5% in the United Kingdom.

Not since the last oil "shock" in 1979, when spot-oil prices rose to \$45 a barrel, have energy prices been a real driving force in international and domestic energy conservation programs. The motivation for improving energy conservation has therefore slackened and performance has suffered.

⁴ Energy Policies and Programs of IEA Countries, 1989 Review, International Energy Agency, Paris.

⁵ Source. IEA prices with taxes adjusted to a common base.

Energy and the Environment

At the 1989 annual meeting of the federal and provincial energy ministers, the topic of greatest interest was the Intergovernmental Task Force on Energy and the Environment's recommendation to set a target of 20% reduction in CO₂ emissions by the year 2005. The task force estimates that CO₂ emissions from domestic consumption of fossil fuels will rise nearly 50% from the 1988 level of 473 million tonnes to 706 million tonnes in 2005.

An independent study (DPA Consulting Group, Toronto) of the techniques and costs of meeting this ambitious goal pointed to three levels of effort. The first step would involve use of operating cost inducements to improve combustion efficiencies, shift to lower carbon emitting fuels like natural gas, replace coal and oil-fired generation of electricity, etc.

The second level would require some financial incentives to raise economic returns to industry standards. In this endeavour, emission reductions could amount to 160 million tonnes per year and save \$1 billion (\$108 billion after capital costs are netted out).

Step three – further reductions of 234 million tonnes – could be achieved by introducing measures based on technologies now being developed. This effort would require some \$100 billion investment, but net \$72 billion in savings (not including the benefits of environmental improvement) would come from a \$177 billion reduction in energy cost.

The Task Force concluded that the most cost-effective means of reducing CO₂ emissions is through energy conservation and improved efficiency.

Potential Annual Energy Savings

According to the results of the latest Ontario Ministry of Energy Industrial Energy Services Program (IESP) survey, there is no shortage of quick-return opportunities in the manufacturing and mining industries.

This highly successful program, that focuses primarily on quick-return retrofits, has identified average annual savings of 9.5% from retrofits with simple economic paybacks of less than 1.9 years. A large number of longer payback improvements have also been found, but these have not been included in

this high priority list.

The most frequent retrofit opportunities still being found by the Ontario IESP program are shown in Tables V and VI. Improvements to electrical systems provide 1.6 year simple paybacks on investments, HVAC systems yield 2.4 year returns, combustion system improvements have 1.9 year returns, steam systems provide 1.1 year paybacks, production scheduling can yield 0.9 year paybacks and process alterations using known technologies have great potential with only 1.9 year paybacks on new investment.

The quickest techniques still involve reducing steam system pressure and repairing steam traps. This situation hasn't changed much since CIPEC monitoring began 14 years ago, because the majority of quick-return opportunities require constant maintenance to be effective and always become more viable as energy prices increase.

With these kinds of opportunities and short economic returns, it is evident that performances could improve with more staffing, more widespread monitoring and control and a modest adjustment in capital budgets.

Table V

Energy Efficiency Opportunities

Source	Number	Capital Cost (\$,000)	Annual Savings (\$,000)	Simple Payback (years)
Electrical	402	13,609	8,520	1.6
Space Heating	271	8,981	3,827	2.4
Combustion	233	9,572	5,139	1.9
Steam Systems	96	1,751	1,578	1.1
Scheduling	44	556	636	0.9
Process Changes	330	32,523	17,062	1.9
Miscellaneous	82	5,830	4,964	1.2
Total	1,458	72,822	41,721	1.8

Source: Ontario Ministry of Energy

Table VI

Top Ten Energy Efficiency Opportunities in 315 Plants

	Number	Annual Savings (\$,000)	Percent of Total
1. Process Design/Operations	53	4,409	10.8
2. Heat Recovery from Process Streams	84	4,069	9.9
3. Demand Controller/Load Shedder	102	3,547	8.7
4. Heat Recovery from Boiler Stack	92	2,712	6.6
5. General Lighting Improvements	160	2,691	6.5
6. Heat Recovery from Process Equipment	32	2,437	5.9
7. Process Equipment Replacement	25	2,404	5.8
8. Process Heat Recovery for Space Heating	50	1,097	2.7
9. Boiler Air/Fuel Controls	57	891	2.2
10. Power Factor Improvements	101	759	1.8

Source: Ontario Ministry of Energy

Spending on Energy Efficiency RD&D

Canadian industry's long-term energy-use and efficiency is also directly affected by the rate of national RD&D spending and the effectiveness of technology transfer activities.

The overall level of energy R&D spending in fiscal 1987/88 (latest available) was \$902 million, of which \$489 million was spent in industry - \$327 million by the federal government and \$86 million by the provincial governments. Federal government spending consists of funding of nuclear R&D (45%) expenditures co-ordinated by the inter-departmental Panel on Energy Research and Development (PERD) (27%) and other agencies (28%). PERD funding includes a broad array of subjects including oil sand/heavy oils, coal supply and combustion, oil/gas/electricity development, new liquid fuels, energy conservation and renewable energy and nuclear fusion. In recent years, there has been some shift in emphasis from fossil fuels to energy efficiency, alternative energy sources and the environment, but the major emphasis is still heavily weighted on supply and development of expensive new sources.

As well, the federal government budgeted \$253 million over 5 years for Energy Efficiency and Diversity (EED) initiatives to further promote efficiency, increase the penetration of viable energy alternatives, improve energy's impact on the environment and support these initiatives with near-term low-risk R&D efforts. But under EMR's modified new mandate, activities are now becoming more information oriented (intelligence, technology transfer, standards, etc.) and less involved with promotional programs.

Provincial R&D priorities follow particular local interests. Alberta, with its emphasis on fossil fuels, accounts for about 70% of the provincial energy R&D expenditures. Quebec has a substantial program related to the further electrification of the province. In eastern Canada, coal is the focus of attention. Other provinces tend to concentrate on energy efficiency and renewables.

In comparison with other OECD countries' spending, Canada's energy analysis budgets are shown in Table VII. Since 1983, Federal government actual spending on energy systems analysis has decreased by 75%.

Status of Energy Conservation

In view of these circumstances and the rise of environmental concern, several task forces asked participants to rank the importance of energy-use efficiency, remaining sources of improvement and barriers to future improvement. The remarkably uniform responses among surveyed groups only differed in the relative weight given to the identification of issues and minor realignment of some of the source items special to each industry. The general manufacturing aggregate results are shown in Table VIII. In the past few years, energy management programs have gradually evolved into specialized energy management activities where the emphasis was mainly on reduction of operating expenses, administration of natural gas "buy-sell" contracts, etc. With the rise of environmental concerns, however, companies are now in the process of revising their strategies and again looking at the broad implications of energy use, including attending to waste disposal problems.

Many progressive Canadian companies have now combined energy and environmental affairs into one senior job responsibility. Many firms have also reactivated p

Table VII Government RD&D Budgets for Energy Systems Analysis
(in millions of \$U.S.)

	1983	1984	1985	1986	1987	1988	1989
Canada	20.6	16.7	8.9	8.1	6.9	5.4	5.3
U.S.	386.7	349.7	430.5	402.1	357.3	405.2	413.8
Japan	54.2	60.8	34.5	25.6	27.3	20.3	17.7
Germany	24.1	4.2	2.9	5.3	n/a	0.1	0.2
Netherlands	15.8	15.4	15.7	17.4	21.6	21.4	22.2
Italy	13.3	25.6	14.4	30.2	165.0	225.0	261.0
Sweden	15.2	11.1	15.7	16.5	15.7	21.5	18.7
U.K.	66.0	62.3	65.5	32.7	30.7	33.9	27.2

Source: IEA country submissions.

Table VIII

Status of Energy Management

General Concerns		Improvement Sources		Barriers	
Product Quality	88.3	Monitoring & Control	64.4	Economic Payback	76.5
Safety & Health	84.1	Process Technology	62.5	Other Priorities	56.5
Profit Improvement	82.9	Housekeeping & Maint.	58.7	Staff Limitations	56.8
Labour Productivity	80.6	Electrical Systems	52.5	Uncertain Business	52.9
Plant Equipment	68.2	Combustion Systems	51.5	Technical Constraints	52.3
Pollution	67.6	Other Utilities	50.6	Impact on Occupants	51.7
Energy Efficiency	62.9	Buildings	50.6	Government Incentives	51.1
Raw Material Prices	61.1	Waste Heat Recovery	50.0	Detailed Information	41.1
Training	55.3	HVAC	41.8	Impact on product	37.6
R&D	37.6	Materials Handling	33.3	General Awareness	28.8

performance auditing on a broader scale. The status and profile of the multiple-E manager (engineering, energy, environment) is now on the rise.

From the survey response, the commitment and weight given to each item suggests that industry is still very much preoccupied by immediate operating concerns. Product quality gets three times as much attention as R&D, and monitoring and controls are higher priorities than implementation of complicated projects — especially when economic paybacks are long and corporate resources are limited.

But as a result of growing competitive pressures, staff limitations and greater technical complexities, more companies are turning to provincial energy auditing programs and electric utility DSM programs for technical and financial assistance.

Electric Utility Demand Side Management Activities

Perhaps the most significant initiatives that will help raise future energy-use efficiency, and thereby help improve the environment, are contained in the various Demand Side Management programs² introduced by the provincial governments and local electric utilities. These comprehensive programs are geared to the specific needs of all their constituents, and because of

their specific goals, promise measurable and well-balanced results. In general, they offer focused promotional activities, professional assistance, specific financial incentives and regular impact assessments. This approach usually constitutes a recipe for sustainable results.

Industry therefore has a vital interest in the cooperation and success of these DSM programs, not only because more than half of its energy cost is now spent on electricity, but also because of social and economic impact involved in providing the "least-cost" sources of future power.

What's more, since most conventional electricity generating facilities are only about 35% efficient, the multiplying effect of reducing industry's end-use demand also helps lower the amount of "greenhouse" gases emitted to the environment. It therefore means that industry will have an extended responsibility for environmental protection beyond the limits of its own property.

The following is a summary of the current DSM programs:

British Columbia

The B.C. government recently introduced the Industrial Electricity Rate Discount Act (Bill 28), and the Critical Industries Act (Bill 31) to help industry with reduced power rates. These programs will be replaced

within 3 years by strategic conservation measures.

The B.C. government also intends to deregulate electric power production. It has therefore set the state for Independent Power Production (IPP) in the province. Investor-owned utilities can generate electricity and directly negotiate contracts with large customers. B.C. Hydro is required to wheel power from independent generators as well as that generated by companies for use in their own subsidiary operations.

B.C. Hydro's annual output varies between 42,500 GW.h and 52,000 GW.h depending on hydraulic conditions. An additional 3,200 GW.h can be provided from existing thermal plants. The total average cost of operating the system is about 4.0 cents per kWh. There is no surplus beyond the normal amount required for reliable supply, planned maintenance outages, etc.

B.C. Hydro therefore has a 24 point comprehensive DSM program now in operation and intends to invest \$345 million (30% for industry) to reduce consumption by 48,000 GW.h over the next 20 years. This will displace 800 MW of equivalent generating capacity.

² "Demand Side Management in Canada", published by Energy, Mines and Resources Canada and Canadian Electrical Association.

Cogeneration is seen as a major way of providing power to ratepayers at costs below that of conventional new facilities. Most of the existing cogeneration is in the pulp and paper industry (470 MW) and wood products industry (75 MW). In 1989, 35 submissions were presented for IPP projects totalling some 1,795 MW of non-utility power.

West Kootenay Power and Light Company Limited is a privately owned utility with 4 hydraulic stations plus access to power generated by Consolidated Mining Ltd. and B.C. Hydro. However, West Kootenay is planning to reduce its purchased power and also has introduced a comprehensive DSM program.

Alberta

The Alberta government does not have an official DSM policy but does provide a wide range of energy awareness activities.

Alberta Power Ltd. is a publicly owned company that generates about 1,224 MW from 7 interconnected thermal plants fired by coal or natural gas. Industry uses 60% of the total capacity. The utility anticipates retail sales will grow about 7% per year until 1994. Cogeneration is actively promoted. Rate structures include TOU and incentives for peak clipping.

TansAlta Utilities Corporation is also an investor-owned company with 3 large coal-fired and 13 hydraulic facilities. Industry uses 47% of the total 4,293 MW generated. DSM incentives concentrate on rate structures that promote the wise use of electricity.

Edmonton Power is the largest municipally owned utility in Canada. Two gas fired 1,208 MW plants provide peaking power to supplement purchases from neighbouring utilities.

Saskatchewan

The Saskatchewan Power Corporation provides about 12,969 GW.h of power from 5 hydraulic, 4 thermal, and 3 gas turbine facilities. In addition, SaskPower uses diesel generators to produce some off-grid power. Cogeneration potentials are being studied.

SaskPower's DSM initiatives centre mainly on provision of interruptible and off-peak rate structures and purchase of a limited supply of power from independent generators. This amount is currently limited to 50% of the new growth in demand.

Manitoba

The Manitoba government supports a number of DSM-type initiatives which focus on strategic methods of conservation. These include free audits, advice on implementing energy management projects and programs and energy awareness activities. A target of 100 MW reduction over the next 12 years has been established.

The capacity of Manitoba and Winnipeg Hydro is about 3,900 MW from 13 hydraulic and 2 coal-fired thermal facilities. It is anticipated that capacity will be in a surplus position – low water levels notwithstanding – until 1999.

Industrial DSM activities are concentrating on end-use efficiencies, ground source heat pumps and electrotechnologies.

Ontario

The province of Ontario operates an extensive list of programs designed to suit the needs of industry and other sectors. These include a comprehensive industrial energy auditing program, an energy monitoring demonstration program and an energy technology development program.

In its energy policy paper entitled **AN ENERGY EFFICIENT ONTARIO TOWARD THE YEAR 2000**, Ontario's key objectives are stated as follows:

- Energy efficiency and conservation will be the major priority meeting the province's future needs for energy services;
- DSM programs will be used to extend the time before Ontario needs new electrical facilities;
- The potential for strategic conservation is estimated to be 1,000 to 4,000 MW of peak reduction by the year 2000;
- Programs will be designed to motivate end-users to conserve energy before having to add new generating facilities, taking due consideration of environmental and other social costs;
- Ontario Hydro and the municipal utilities will play a lead role in improving the energy efficiency of Ontario; and
- The government will coordinate the energy efficiency activities of the utilities.

Ontario Hydro, with 68 hydroelectric, 9 thermal and 3 nuclear facilities has a generating capacity of about 30,333 MW. According to Ontario Hydro, recent annual growth in peak demand has increased about 5% but is expected to subside to about 2.4% per year in the 1990s. According to Hydro studies³, even with a proposed new 3,500 MW nuclear plant, surplus capacity is not considered sufficient past 1995.

Ontario Hydro therefore has launched a comprehensive DSM program designed to avoid 4,500 MW of generating capacity by the year 2000. A further 750 MW of loads have been identified for selective interruption when necessary.

Ontario Hydro plans to spend \$917 million on DSM between 1993 and 1994. By the year 2000, Hydro's total commitment could be as high as \$2 to \$3 billion.

³ Ontario Hydro, Providing the Balance of Power, 1989

Hydro estimates that 73% of industry's consumption is used for motor loads, 16% is used for process heat and electrolysis, and 11% is used for lighting.

Hydro's industrial DSM activities will focus on load shifting, peak clipping and conservation. The program includes a full array of information activities, incentive driven programs in the early 1990s and loader scale implementation initiatives in 1993. DSM potentials of 150,000 MW of parallel and cogeneration, 400-750 MW of load shifting and 200-700 MW of general efficiency improvements have been identified as goals for the year 2000. Industrial users with large motor loads will get high priority attention. Reduction of TOU rates in "direct customers" will be gradually extended throughout industry. End-users that are candidates for load shifting, especially in the cement, chemical and pulp and paper industries will also receive special attention. Energy management/audit programs will cover all sectors.

Where Independent Power Production (IPP) is involved, which will increasingly involve industrial plants, Hydro will base buy-back prices on the "avoided-cost" concept. For example, the cost of adding new generating facilities, according to Hydro's "Demand/Supply Plan Report" (Chapter 6) amount to some 10 cents/kWh for independent high-load factor gas-fired cogeneration and 5.3 cents/kWh for construction of new hydraulic generating facilities. However, Hydro recognized other extenuating circumstances, such as the constrained distribution systems in certain regions, lack of availability, reliability, etc.

Quebec

The province of Quebec, through its Bureau de l'efficacité énergétique (B.E.) has a number of programs relating to energy efficiency. Industrial DSM activities emphasize energy conservation, load shifting,

and peak clipping. An industry-commercial technology-transfer program, a technology demonstration program, and free technical audits are provided.

The main feature of Hydro-Quebec's DSM program is to apply planned interruptible contract options more frequently, which could enhance the overall cost-benefits to end-users and the utility by limiting peak demand. Interruptible power is to increase from 760 MW to 1200 MW by 1996.

New Brunswick

The provincial government believes that energy is a key instrument to be used in promoting and managing its economy. Accordingly, a loan program exists to promote energy conservation and use of alternate resources to displace purchase of foreign oil. For example, private interests have been invited to bid on building, owning and operating a model 25 MW wood-fired power plant.

New Brunswick promotes energy efficiency through information services and provides on-site audits. Several R&D programs, including demonstrations, are sponsored.

The New Brunswick Electric Power Commission generated some 12.4 million MW.h in 1989 from nuclear (35.3%), hydro (14.1%), oil-fired (39.5%) and coal (11.1%) plants. Adequate surplus capacity exists until 1996-97. Industrial DSM activities have the highest savings potential and will concentrate on cost-effective peak-clipping efforts.

Prince Edward Island

The province has formulated long-term DSM type policies to provide the "least-cost" options for power to reduce its dependence on foreign oil, promote wood-fired cogeneration and better manage loads in its commercial and industrial sectors. The province subsidizes electricity costs of approximately 100 of P.E.I.'s key manufacturing and processing companies.

Because of DSM initiatives, the

Maritime Electric forecast of long-range demand increases should be held to 2.9% per year. Broader application of interruptible rates is discouraging the equivalent of 14 MW while the "Beat the Peak" program is saving 2MW of peak demand. The industrial interruptible rate structure is reducing MEL's firm demand by 11%. A centrally controlled load reduction system was installed in 1989.

Nova Scotia

The province sponsors a number of EE/DSM initiatives for industry's benefit. These are focused mainly on demonstrations related to alternate fuels, point-of-use audits, an energy award program and, through the Public Utilities Board (PUB), the start of appropriate DSM activities.

The Nova Scotia Power Corporation set a new peak generation of 1,707 MW in December of 1989. The 1989 load forecast projects a 10 year annual growth of 3.5%. DSM actions have been identified as one of the means of dealing with the expected shortfall of capacity at the turn of the century.

Newfoundland

Newfoundland and Labrador Hydro (NLH) generates some 1,417 MW from the island and 5,400 MW from its Churchill Falls mainland source for sale to Newfoundland Light and Power (NLP) and Hydro-Quebec. Blessed with an abundance of hydraulic potential, NLH plans long-term expansion with short-term makeup from other sources, including purchase from independents such as Abitibi Price.

NLP is in the conceptual/development stages of formulating a DSM program. Ground-source heat pumps, energy-efficient lighting and general energy efficiency methods are contemplated.

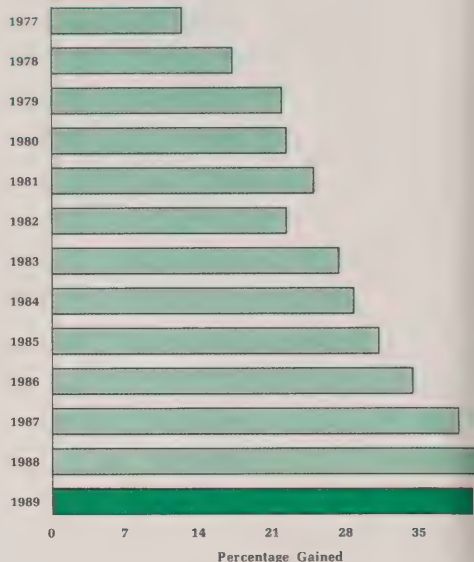
Yukon and North West Territories

The territorial governments offer a number of focused programs to promote general conservation but do not have DSM policies at this time.

Chemical Industry

Energy Conservation Task Force

David Shearing
Chairman



The chemical industry is the third largest energy consumer and has the fourth highest energy intensity per GDP of all of Canada's manufacturing industries. Chemical producers use 15.5% of the domestic secondary-energy demand, exceeded only by the pulp and paper and steel making industries, and equal to the total energy consumption in the mining industry.

The efficiency results contained in this report are based on a survey of the Canadian Chemical Producers' Association (CCPA) membership which represents about 80% of the total industry. This survey includes a broad spectrum of companies including those that spend less than \$100,000 for fuel and electricity as well as large integrated firms that spend over \$200 million on energy and feedstocks.

Based on the value of shipments, 63% of products from this industry are classified as petrochemicals, 25% as inorganic and nearly 12% as organic and specialty products. Eleven percent of the industry is located in British Columbia, 29% in Alberta, 41% in Ontario, and 10% in Quebec.

1989 Performance

Energy efficiency declined 1.6% in the surveyed companies during 1989. This performance drop lowered the group's overall gain to 39.4% since the original 1973 base year and 8.3% since the updated 1985 base year.

The sluggish performance started last year when efficiency gained only 1.5%, whereas the usual increases average about 2.2% per year.

Energy efficiency was affected by a number of business and related operating factors that began to cloud the industry in 1988. The main factors include a decline in production output and reduction in capacity utilization. Together with a slower rate of investment in 1988 and a drastic drop in profits in 1989, operating conditions and consequent energy performance appear to be a repeat of the situation during the 1975-1982 business cycle.

The strong link between energy efficiency trends and changes in capacity utilization with production levels is evident from similar results reported during the 1975-1982 business cycle.

In 1982, energy efficiency dipped 2.6% when production went down 11% during the year. Since then, energy efficiency was pushed up 17% while capacity utilization increased from 71.9% to 94.4%. The impact of changing capacity utilizations is not as great before because of a broader base commodities and better control plant operations. However, energy performance suffers when all conditions are unfavourable.

During 1989, production was flat for most companies in the inorganic and specialty sectors while output in the petrochemical group was the hardest. In the petrochemical sector, output was off 8% while the total industry drop was 6.6%. Facing rising interest rates and slow sales, companies had to reduce output knowing that energy efficiency would slacken at the lower operating rates.

In 1989, total end-product sales dropped to \$9.04 billion from \$10.1 billion in 1988. Profits (before interest, taxes and special write-offs) declined from \$3.1 billion to \$1.1 billion mainly because of a rapid slump in petrochemical prices. D

a world-wide oversupply of some commodities such as ethylene and methanol, it will take time to adjust to this changing global market situation. Profits in the Canadian industry are expected to slide a further 2% in 1990. In this depressing situation, companies trim operating expenses, cut discretionary projects, mothball old plants, slow the rate of new investments, reduce staff and wait for a more favourable time to advance.

The investment rate on new equipment has a large impact on performance even though there is an approximate two year time lag in performance results. Reduced 1989 energy efficiency would have been affected by the slow 1.4% rate of growth in investment in 1987-88. However, the effect of a record high \$15 billion (up 41%) rate of investment in 1989 and a forecast of a like amount for 1990 may help restore energy gains to previous levels.

There is also a noticeable drop in the reported number of small re-profits because of growing capital intensity, higher interest rates, and greater business uncertainties. Introduction of a 7% Goods and Services Tax (GST) will also reduce the purchasing power of the consuming public, which could dampen a return to a more profitable situation.

The relationship between capital spending on energy performance and other concerns, such as the environment, is drawing close attention from government in its endeavour to set new policies affecting these issues. According to a special study¹ by Statistics Canada, the entire manufacturing industry is spending only about 1% (\$151 million in 1987) of its new capital investment on specific projects that reduce energy operating costs.

According to the study, the chemical industry spent \$2.025 billion on new equipment between 1985 and 1987 of which 61% went towards capacity expansion and 28% for modernization.

The chemical industry, unlike any general manufacturing indus-

tries, must spend a high percentage of its investment on energy improvements because of the nature of its processes and capital intensity of its equipment. Given some of the highest energy intensities, total fuel and electricity cost estimated at some \$1.3 billion in 1989, and energy costs that can amount to as much as 70% of total manufacturing expenses, continued investment is critical to future competitiveness. It is estimated that close to 20% of all new investment has a direct impact on energy operating efficiency. The numerous retrofits and expansion examples detailed in this report in previous years demonstrate this pattern. A definitive recent example of this ratio was contained in the Cargill/Manitoba government nitrogen fertilizer plant announcement. At a cost of \$379 million, \$29 million was identified as design enhancements intended to increase the energy operating efficiency.

The Statscan study also shows the entire manufacturing industry is now spending twice as much on environmental improvements as for energy related projects. While the pattern within the chemical industry is not clear, undoubtedly there is considerable environmental investment given the new industry-wide "Responsible Care" program. In isolated cases, companies already report that energy performance suffered directly because of environmental retrofits. In other cases, energy utilization improves as a by-product of environmental investment. For example, Du Pont Canada Inc. has created a viable new plastic fencing business using recycled materials. As well, Du Pont has announced that it will reduce by half all potentially toxic emissions from its operations within five years and, where possible, safely use the recovered wastes as boiler fuel.

On a broader perspective, there is a global chemical industry capital/productivity upgrading trend under way. Emerging free trade blocks, such as the European Economic

Community, and political changes in Eastern Europe are changing the face of international competition. Even though Canada's chemical industry is helped by an abundance of cheap natural gas, energy costs are increasing faster (6.2% in 1989) while raw material costs dropped 7.2% and other major factory expenses remained stable. This situation should cause industry management to focus renewed attention on energy performance with beneficial effects.

The Canadian chemical industry itself is in the midst of a major restructuring which has resulted in difficulty in tracking annual performances. An increased number of levered acquisitions, privatizations, divestitures, etc., has created a volatile situation in which some of the regular participants could not respond to the survey this year.

The 1990 forecast improvement level of 40% that was surpassed last year, then lost this year, may yet be regained if business volumes stabilize and the impact of more efficient plants brought on by the large investment in recent years begin to pay off.

Energy Consumption and Costs

Consolidated energy use trends are shown in Table I below. Results show there has been a 6% share increase in the use of natural gas in the past four years, half of which resulted from the substitution for fuel oil and the other half because of increased feed stocks in the petrochemical industry. Energy efficiency is determined on the basis of fuel and electricity consumption and normally does not account for changes in feed stock consumption.

There was also a slight increase in use of natural gas with a corresponding reduction in propane because of cost differences.

The growth of the electrical share was slower in 1989 partly because of the conversion of some electric steam boilers back to fossil fuels in Quebec. Hydro Quebec has brought

¹ Analysis of the Categories of Capital Investment, 1985-1987, Statistics Canada

Table I

Chemical Industry Energy Use and Trends

Type	Units (,000)	Gigajoules	1989	1985	1980
Natural Gas	5,346,017 m ³	198,871,870	51.0	44.4	36.8
Electricity	9,935,570 kWh	104,830,200	27.0	34.7	31.1
Liquid Petroleum Products:					
Distillate Oil	83,136 litres	3,378,800	1.0	0.9	10.0
Residual Oil	176,508 litres	7,462,400	2.0	4.2	14.4
Diesel and Gasoline	11 litres	459	—	0.5	0.4
Other Fuels:					
Propane, LPG	163,782 litres	4,356,600	1.8	1.0	—
Coal & Coke	51.7 tonnes	1,200,000	0.4	0.3	2.3
Steam	n/a	10,630,635	3.3	2.0	1.0
Other Fuels	n/a	57,661,300	15.0	12.0	4.0
Totals	— 1989	388,383,290			
	— 1988	381,712,677			
	— 1987	428,905,604			

Other fuels include process by-products, vent gases, "drips", "slops", pitch, sulphur, hydrogen, waste oils, etc. Electricity is converted at 10,551 kj/kWh.

back some incentive contracts to temporarily discourage electrical consumption because of the low water levels in its hydraulic generating facilities.

The shifting share trends are similar when electricity is converted by the net 3600 gigajoules (GJ)/kWh rates. Using this net rate, share distributions change to: electrical 12%,

natural gas 61%, fuel oil 3%, propane 2%, purchased steam 5% and 17% for wastes used as energy. In either case, the cost share for electricity amounts to 33% of the total estimated \$1.35 billion energy expense.

Additional recovery and use of "waste" fuels has had a major impact on energy conservation per-

formance and cost reduction. Between 1985 and 1988, the growth rate slowed to half of its former rate. In 1989, however, the rate jumped again as companies such as those noted above have renewed efforts towards recovery as part of their environmental control programs. Even so, many companies are recycling more by-products into processes for recovery.

Table II

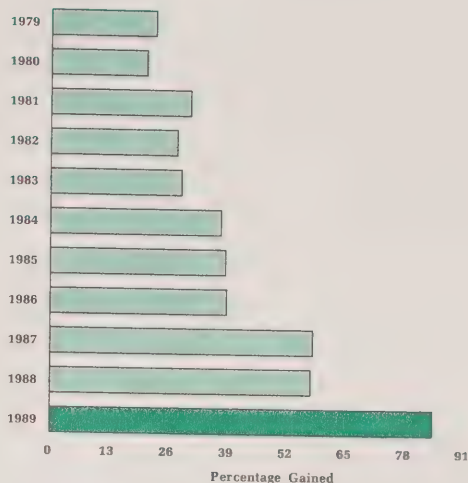
Chemical Industry Energy Efficiency Improvement

Current year (1989) total energy inputs	388.383 terajoules
Base year (1985) equivalent energy inputs	418.763 terajoules
Adjustments (1985-1989)	.930 terajoules
Net Improvement	= 9.38%
Efficiency gain 1973 - 1985	30.0
1986	4.4
1987	5.2
1988	1.5
1989	-1.6
Total gain 1973 - 1989	39.6%

Electrical and Electronic Industry

Energy Conservation Task Force

Steve Horvath
Chairman



A banner year". This phrase best sums up the electrical and electronic manufacturing industry's 1989 experience on all fronts. Energy management was no exception.

The 49 companies submitting energy consumption data for this Task Force summary reported a record 34.7% improvement in energy efficiency for 1989 compared to 1988. Task Force members attribute this significant result to three factors:

- **A banner year in productivity:** If 1988 was a great year, 1989 surpassed every manufacturer's expectations. Production levels, in response to consistent high demand for products, rose to all-time highs; plants operated at almost full capacity – topping the 95% level.

Because the electrical and electronic manufacturing industry uses relatively little energy to actually manufacture its prod-

ucts (most energy is used for heating, lighting, etc. which vary only slightly when production levels rise), increased output dramatically improves the energy efficiency picture for companies in the industry. A number of companies thus were able to report energy efficiency improvements in the magnitude of 30, 40 and even 50%.

- **Rationalization of company operations:** In response to the challenges of the global marketplace, companies are looking at any number of ways to improve effectiveness in their production operations. In the electrical and electronic industry, this often takes the form of product rationalization; a company will produce a high quality product in the most cost efficient method in order to supply the global marketplace. This too has a positive effect on productivity – thus helping improve the

reporting company's energy statistics.

- **A change in the reporting base:** Although the number of reporting companies in 1989 was lower than in 1988 (when 58 participated), the actual reporting base has changed significantly. This reflects a major realignment that is taking place in the electrical and electronic industry itself. Twenty-one companies which contributed to the 1988 survey did not provide statistics for this 1989 report. Many are major energy consumers involved in mergers, divestitures of product lines, sell-offs and other reorganizational activities which caused a disruption in the reporting of their energy usage.

The 13 new companies participating in the 1989 survey contributed significantly to the industry's improved energy efficiency picture.

Energy Use Patterns

Total energy used by reporting members dropped sharply in 1989 to 4.6 million gigajoules (GJ) from 7.07 million GJ the previous year. Despite this drop, the relative distribution of energy sources remained fairly constant, with natural gas and electricity being the preferred energy sources. Oil consumption increased to just over 7% from 2%. This trend can be partly attributed to the relatively low price of oil during the past year.

E & E Industry and the Task Force: A Challenging Future

The more than 200 companies represented by this task force manufacture a diverse range of products used in the generation, transmission and distribution of electricity. Examples of this include generators, transformers, lighting equipment, wire and cable and electrical appliances. Companies represented by this task force also manufacture a variety of electronic products, systems and related high technology components. The majority of these companies are members of the Electrical and Electronic Manufacturers' Association of Canada (EEMAC), which acts as a secretariat for the task force.

Many of these E & E industry manufacturers face significant competitive challenges as global competition and free trade with the U.S.A. become realities. The industry reorganization that began in 1989 and continues into 1990 and beyond is but one way in which the industry is restructuring to be more competitive.

"The challenge for this task force", says Steve Horvath, Chair-

man of the Electrical and Electronic Industry Task Force, "is to strengthen the role of energy management. In the face of these major changes, our member companies should integrate energy management and environmental consideration directly into their manufacturing and product development decision-making procedures."

- **Put energy management back on the front burner:** As companies have reorganized to modernize and be more globally competitive, energy management has lost its identity as a significant function. This is partly because many companies already have implemented their most substantial energy conservation measures. Low energy prices in the past few years mean payback periods for energy conservation programs are often longer than other modernization projects. Energy conservation loses out in the battle for capital dollars. Increased pressure to be environmentally responsible has also meant a change in corporate priorities.

The task force's job, in 1990 and beyond, will be to help companies understand how energy management is an integral part of the way they will have to do business in the next decade and the next century. Looming electricity shortages in many provinces will make demand side management a reality for both companies and individuals. Environmental and energy issues are often inextricably intertwined. It will be the task force's job to help drive home these messages

to members and help them devise appropriate response strategies.

- **Rebuild the task force profile** The federal government's decision to suspend CIPEC operations in 1989 put all of this task force's planned activities on hold. This report is our major activity for the past year.

In 1990 we therefore will be in a "rebuild" mode. This task force will emphasize educational activities in 1990 both to raise the level of awareness of energy management and to increase the commitment of industry in support of the task force.

Initial indications are promising: A tour of the Darlington Nuclear Facility and review of the Ontario Hydro Demand Supply Plan early in the year drew more than 40 company representatives. Three more meetings are planned for 1990 featuring guest speakers on a variety of relevant topics.

The Future Outlook

Indications are that a general air of uncertainty will prevail in 1990 fuelled by the GST, free trade, high interest rates and the high Canadian dollar. In this kind of environment capital spending likely will be curtailed sharply, a move that will adversely affect energy efficiency programs. This trend, coupled with an expected downturn in the economy and production levels, could see this task force report little progress, or even a negative efficiency factor, for 1990. Only time will tell.

Table I

Electrical and Electronic Industry Energy Efficiency Improvement

Current year (1989) total energy inputs	4,619,121 GJ
Base year (1988) equivalent energy inputs	7,075,361 GJ
Net Improvement	= 34.7%
Adjustments — None	
Efficiency gain 1975 - 1985	36.1
1986	1.9
1987	16.2
1988	-1.2
1989	34.7
Total gain 1975 - 1989	87.7%

Table II

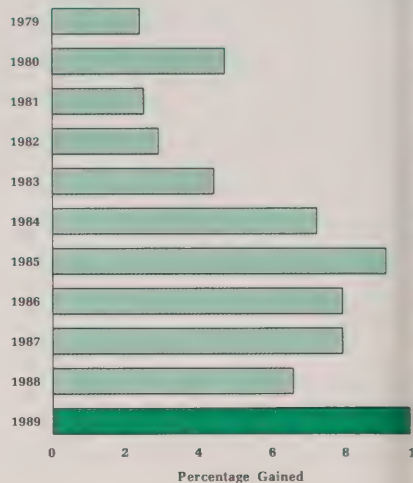
Electrical and Electronic Industry Energy Use

Type	Units	Gigajoules	1989	1988	1987
Natural Gas	64,216,057 m ³	2,524,730	54.7	57.6	54.8
Electricity	425,738 MWh	1,620,906	35.1	36.7	41.1
Liquid Petroleum Products:					
Distillate Oil	2,959 kilolitres	114,979	2.5	1.0	0.9
Residual Oil	5,806 kilolitres	235,126	5.1	1.1	1.2
Diesel and Gasoline	403 kilolitres	15,155	0.3	0.2	0.1
Other Fuels:					
Propane	1,008 kilolitres	28,663	0.6	0.5	1.2
Steam	2,979,850 kilograms	79,562	1.7	2.9	0.7
Totals	1989	4,619,121			
	1988	6,273,070			
	1987	6,689,830			

Ferrous Metals Industry

Energy Conservation Task Force

Denis Jones
Chairman



Task Force Description

The Ferrous Metals Industry Energy Conservation Task Force is represented by the steelmakers who comprise the Ferrous Industry Energy Research Association (FERA). The companies which provided data for the 1989 energy efficiency assessment include:

1. The Algoma Steel Corporation
2. Dofasco Inc.
3. Stelco Inc.
4. Sydney Steel Corporation (Sysco)

Together, these companies represent about 70% of total Canadian raw steel production and produce steel by the following techniques:

- a) blast furnace and basic oxygen steelmaking
- b) electric steelmaking furnace

A partial listing of steel products would include:

- structural shapes
- rails
- flat rolled products
- forgings
- fasteners
- coated steel
- castings
- tubular products
- bar products
- wire and wire products

Steel is produced and/or processed in 23 plants operated by the member companies.

1989 Composite Energy Performance

Due to a decrease in the number of reporting companies, reported steel production declined in 1989 to 11,201,350 tonnes from 11,917,564 tonnes in 1988. All current and past statistics have been adjusted to reflect only current reporting companies.

The amount of energy consumed per tonne of raw steel was lower in 1989, at 23.23×10^9 Joules (J), than in 1988, at 24.38×10^9 J (a decrease of 4.7%).

All participating companies achieved success in their planned energy conservation programs, with a number of these achievements listed at the end of this report. Some of the major gains were a result of:

- Reduced hot metal proportion in the steelmaking process
- Continuation of the modernization programs leading to increased proportion of continuously cast steel
- Increased proportion of steel produced by the less energy intensive electric arc furnace method

Progress Towards the 1990 Energy Rate Goal

In 1989, the energy rate at 23.23×10^9 J/tonne was 0.8% lower than

the 1985 base year energy rate of 23.42×10^9 J/tonne and is 5.6% higher than the 1990 energy goal of 22.00×10^9 J/tonne.

Task Force Technical Activities

The Technical Committee of FERA provides opportunities for member companies to exchange information on conservation activities and to become involved in cooperative projects.

In May 1989, one committee member attended the IFRF ninth Member's Conference in the Netherlands. The conference theme was "Clean Combustion in Flames". Topics included:

- Past, Present, and Future of IFRF
- From the 60's Onward
- NoX Control Using Oxy-Fuel Gas Burners
- Modelling of Radiation
- Heat Transfer Calculation for Industrial Furnaces by Monte Carlo method

Direct contact with Federal government research facilities was maintained through an EMR observer on the FERA Technical Committee. On November 9th, 1989, the Committee was given an overview of CANMET's new direction to reduce the global warming trend due to the greenhouse effect.

In November 1989, contact was made with the Ontario Government's Ministry of Energy. A committee member met with the Program Supervisor of the Technology Transfer Industrial Program to discuss current government programs and exchange energy conservation case studies. Programs included:

- Energy Technology Demonstration
- Enersearch

- Industrial Energy Services Program
- Co-Generation Encouragement Program

In mid-1989, the Committee conducted a survey of the cold blast insulating practices within FERA member companies.

The Committee also compiled eight energy conservation 'opportunities' which were implemented in 1988.

Information packages were circulated among Committee members on the following topics:

- Proceedings from Variable Speed Drive Symposium hosted by Ontario Hydro
- Heat pump and Pinch Technology
- Mechanical Vapour Recompression Conference hosted by Ontario Hydro

Conservation Projects for 1990

All participating companies expect to implement energy saving measures in 1990. A sampling of the more significant items includes:

- Addition of an economizer to a large steam boiler
- Commissioning of a new electric arc furnace

1989 Energy Conservation Achievements

The following is a partial listing of energy conservation achievements by Task Force members in 1989.

Modifications to Existing Equipment

- Addition of a recuperator to a large reheat furnace
- Installation of coal tar injection equipment to a blast furnace

- Addition of waste gas oxygen monitoring equipment for improved combustion efficiency
- Installation of cold blast de-humidifiers on blast furnaces

Operating Changes

- Reduced fuel use during reheat furnace shutdowns.
- Reduced purchased fuel flows on boiler pilot flames
- Increased scrap preheating in the steelmaking vessels
- Increased charging of warm slabs into reheat furnace
- Increased production of continuously cast product.
- Increased production in electric arc furnaces.

Housekeeping and Repetitive Maintenance

- Upgrading of building roof insulation
- Steam system conservation programs (traps, leaks, insulation.)

Table I

Ferrous Metals Industry Energy Efficiency Improvement

Current year (1989) total energy inputs	260,232 terajoules
New base year (1985) equivalent energy inputs	262,378 terajoules
Gross Improvement =	-0.8%
Adjustments —	None
Efficiency gain 1974 - 1985	9.1
1986	-1.2
1987	0.1
1988	-1.4
1989	-0.8
Total gain 1974 - 1989	7.4%

Table II

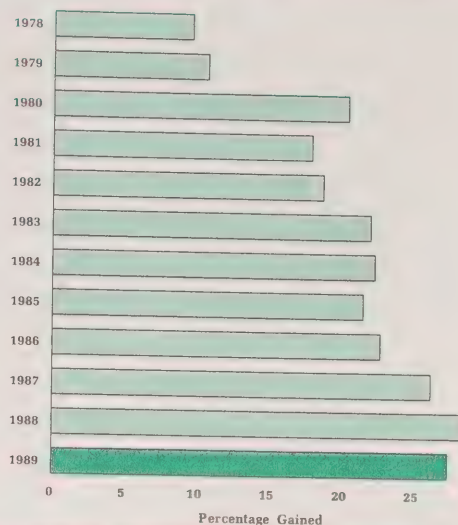
Ferrous Metals Industry Energy Inputs

Purchased Energy	Quantity (SI units)	Conversion Factors	Energy Joules $\times 10^{12}$	Percentage of Total	
				1989	1985
Natural Gas	1,190,833,000 m ³	3.72×10^7 J/m ³	44,299	17.0	15.6
Electricity	4,893,333,000 kWh	3.6×10^6 J/kWh	17,616	6.8	6.2
Residual Oil	508,617,200 litres	40.5×10^6 J/litre	20,599	7.9	4.4
Coal & Coke	6,128,207 tonnes	29×10^9 J/tonne	177,718	68.3	73.8
Total Purchased Energy			260,232		

Food and Beverage Industry

Energy Management Task Force

Alexis L.W. Hyland
Chairman



Overview of Industry

Canada's food and beverage industry consists of some 4300 companies using about 10% of all secondary energy consumed in the manufacturing sector. This highly diversified industry is composed mainly of small companies employing fewer than 50 people. Fewer than 10% of companies are large enough to practice organized energy management.

The industry is undergoing a tremendous amount of structural and technological change as a result of free trade, reorganizations, rationalizations, environmental concerns, etc. Many multi-site companies have revised their entire manufacturing strategies by introducing greater decentralization and branding of products. As companies review their packaging and waste disposal practices, energy, which often constitutes only 3 - 15% of manufacturing costs, is undergoing yet another productivity review.

General Performance

Group energy efficiency dropped 1% during 1989, mainly as a result of general reductions in capacity utilizations and significant setbacks

in companies undergoing major reorganizations. Consolidated efficiency has gained 27% since 1977 and 5.5% compared to the new 1985 base year. Only two previous declines have been reported - one in 1981 as a result of the general recession and the other in 1985 when breweries, distilleries and meat packing companies started to experience major capacity downturns.

Manufacturing capacity utilization in the food sector slipped 2% to 78% while only 53% of beverage industry capacity is being utilized.

Estimated cost of fuel and electricity in the surveyed companies amounts to \$262 million - 38% of the \$676 million spent throughout the entire industry. Energy costs would have been \$70 million higher¹ had there been no efficiency improvements since 1977.

Capital investment in the industry (\$2,100 million) was up 2.9% in 1989 after accounting for inflation, with the biggest spending increases in new equipment and machinery. No increase in spending is planned for 1990. According to participants' responses, only 3% of capital budgets are directed to energy

saving improvements. The biggest spenders are sugar refineries and distillers, each with investment allocations above 10% of capital spending. These two groups also had the highest rate of energy improvement in 1989.

Despite the overall downturn, not all groups recorded lower operating efficiency, as shown in Table 1. The distribution of energy sources and consumption trends are presented in Table 2.

Status of Energy Management

This year, participating members were asked to rank the importance of selected items that impact on energy efficiency, the most likely sources of improvements, and some of the barriers that will affect future performance. While the list is not exhaustive, it paints a good picture of the current operating conditions throughout the food and beverage industry.

¹ This total savings figure should not be compared with previous year's since the reporting population and prices are constantly changing.

Status of Energy Management

Company Priorities		Improvement Sources		Barriers	
Safety & Health	91	Process Technology	76	Economic Payback	82
Profit Improvement	87	Monitoring & Control	75	Business Conditions	79
Product Quality	86	Waste Heat Recovery	68	Lack of Incentives	67
Pollution Problems	79	HVAC, Refrigeration	67	Technical Difficulties	56
Labour Productivity	76	Combustion systems	54	Other Priorities	50
Plant Reliability	76	Maint. Procedures	33	Staff Capabilities	50
Cost Control	71	Electrical Systems	32	Impact on Product	49
Energy Efficiency	59	Materials Handling	29	Analyzed Opportunities	37
Training	47	Air Comp. Systems	28	General Awareness	34
R&D	29	Buildings	14	Impact on Personnel	28

Safety and health remain top management concerns in the industry because of the required integrity of its products. The generally high rating given to profit improvement suggests that profit margins are still unsatisfactory. Compared to these concerns, energy management rates high, even though it is now superseded by growing environment concerns.

Regarding sources of future improvement, process technologies, monitoring and controls were the most commonly recognized. Ratings given to other items suggest that little potential remains to improve facilities, but considerable work still needs to be done on plant utilities. As energy managers progress up the scale of difficulty, solutions become more complex and expensive. This fact has been recognized by those provincial electrical utilities and government agencies offering energy efficiency auditing services. Provincial ministries of energy are now promoting process audits and allotting more time and funds to this lucrative source of energy savings.

Long payback time remains the major barrier to completing many projects. There appears to be no lack of awareness and motivation – just the means and financial resources.

Group Performances

Bakeries

Energy utilization in this sector, including Canada's largest integrated

bakeries, increased by 3.8% during 1989 after reporting a 1% loss in 1988. Efficiency has gained 20.7% since the original 1979 reference year.

Aggregated energy intensity for the various products in this group remains virtually unchanged at 2,658 kilojoules (kJ)/kilogram (kg). This average energy intensity is still about 16% higher than large U.S. operations where larger economies of scale provide distinct cost and efficiency benefits.

The impact of fuel shifts is not clear because some companies had no energy supply options. However, increased consumption of electricity is a common phenomenon in all companies. The electrical power share has grown significantly from 13% in 1979 to 23% in 1989, while its share of total costs increased from 25 - 50%. This increase is due to new proofing techniques and additional product refrigeration. Future electrical growth is expected to be modest.

The group rated product quality, profit improvement, and labour productivity well above other concerns. Energy management ranked four on a scale of 10.

Biscuit Manufacturers

This survey covers 70% of all domestic biscuit manufacturing operations. There are differences in energy intensities among the report-

ing companies, although the average is about 5,900 kJ/kg of output. Energy costs for the processes vary from 10 - 15% of total manufacturing expense.

Energy efficiency dropped 2.1% this year and 1.7% during 1988 to lower the overall gain to 11.6% over the aggregated 1979 operating levels. Survey results indicate that few retrofits have been installed in the past three years and that most companies are relying on basic housekeeping and maintenance activities to sustain their energy efficiencies. When these activities are relaxed performance usually suffers.

Electricity provides nearly 30% of total energy consumption and amounts to 64% of total cost. Natural gas provides more than twice as much energy (68%) while its cost is about half (35%). Consumption of fuel oil is minimal.

The pattern of concerns fits closely the table shown above. Participants said their overall attention to conservation was increasing even though energy is still considered a "low to medium" cost factor.

Breweries

In spite of several improvement projects and close attention to energy costs, breweries suffered a major setback in operating efficiency (-5.9%) this year because of a continuing realignment of company operations. Overall business

volumes were at the same level as 1988. Energy efficiency peaked last year at 9.5% and is now only 3.4% better than 1976 operating conditions.

Two of the largest breweries merged in 1988 and this had a major impact on consolidated results. As well, several micro breweries have become better established and now participate regularly in the survey.

Energy intensities now average around 300 megajoules (MJ)/hectolitre (HL) for large operations and twice this amount for micro brewing. As a result, energy expenses vary from 7 - 15% of direct factory costs, depending on size and location of each plant.

Increased use of natural gas has pushed its share from 55% in 1979 up to the current level of 66%. The heavy fuel oil share has dropped significantly from 18% to 3% of the total mix. All the large brewers contract for gas on "Buy-Sell" agreements while micro breweries get their gas from local distributors at standard commercial/industrial rates.

Canadian breweries purchase proportionately more electricity than U.S. operations. In Canada, 44% of total energy is supplied by utilities, whereas in the U.S. only one-half as much is bought because of the common practice of cogeneration. However, in Quebec, because of low water levels in hydraulic generating systems, Hydro Quebec has introduced a new cogeneration program that will help many Quebec companies offset the high costs of purchased electricity.

The pattern of concerns in this group differs somewhat from the table above. Brewers apparently are directing more attention to development of new products (brands) and hence a higher rating on process improvements than other groups in the industry.

Confectioneries

Partly because production declined significantly in 1989, energy efficiency decreased 8.5%, lowering the overall gain to 24.7% since 1981. In the past few years, confectioneries have apparently undergone more changes than any other group in the industry. Major investment in plant modernization and consolidations should soon begin to raise operating efficiencies.

The proportion of power provided by electricity (32%) and natural gas (65%) has not changed significantly in the past 10 years. Likewise, the energy intensities reported in previous years, e.g. ice cream manufacturing at about 15 MJ/kg, chocolate processing at 13 MJ/kg and other popular confections such as chewing gum at two to five MJ/kg, are about the same.

While product quality and safety and health are top rated business concerns, HVAC and process refrigeration systems were ranked highest for technical improvement.

Distilleries

Energy efficiency increased 7.3% in 1989 as a result of a similar gain in production volume and completion of some waste heat recovery projects started in 1988. In the overall picture, efficiency is 30% better than 1977 operating conditions, in spite of a 25% decline in production. This would suggest that remarkable improvements have been accomplished in this industry.

Aggregate energy intensity of distilled products is presently 39,098 kJ per (absolute) litre.

While natural gas now supplies 87% of total energy and 67% of total expense, electricity accounts for 8.9% of the energy and 30% of the cost. The only change in the past 10 years has been a 17% gain in natural

gas share at the expense of heavy fuel oil. As the energy proportions indicate, the distilling process is mainly a heating operation with little electricity used in the bottling and packaging operation.

Food Processors

Aggregate energy efficiency gained a marginal 0.8% this year after recording a small loss last year. Average gain since 1976 is slightly over 2% per year.

Energy conservation in this group is complicated by the seasonal nature of production, necessity for rapid processing, and thin profit margins which often mitigate against investment in new equipment and machinery. Exposure to the full force of the Free Trade Agreement has placed many food processors in a precarious position.

Food processors generally employ extensive heating and cooling systems that require close attention in order to minimize losses. In the past, some progressive companies have installed government-supported solar heating systems to preheat water, but these are seldom successful because of the low return on investment and operating time. Large processors are now installing gas fired cogeneration units to take advantage of low gas prices and high thermal cycle efficiencies.

Food processors have made a dramatic shift from fuel oil to clean-burning natural gas. In the past 10 years, the share of heavy fuel oil has decreased from 57 - 17% while natural gas has shot up from 20 to over 61%. The electricity share has remained stable near 20%.

Fisheries

1989 was a depressing year for energy utilization in this sector

because of lower production volume (-2.8%), factory shutdowns and attention to other management concerns. Aggregate efficiency dropped 4.3% but is still 25% better than 1978 reference levels.

Electricity is a relatively large source of power, supplying 34% of total consumption. Where electrical loads are essentially constant, any change in production volumes has a large impact on overall operating efficiencies. Since two-thirds of plant electrical loads are used for refrigeration and material handling systems, and given the nation's highest prices and 12-month large ratchet-rate contract structures, load control continues to be the main focus of attention.

The balance of energy is supplied by fuel oil in the Maritime Provinces, and natural gas in British Columbia. Three percent of the total fuel comes from fish oil and other plant wastes.

Product quality, labour productivity, and safety and health far outpace the concern for energy efficiency. As for improvement potential, HVAC and refrigeration are the top items with process technologies at the bottom of the list. Barriers to improvement are shown in the general listing.

Grocery Products

Companies in this sector make or process a large number of different products such as coffee, pasta, soup, canned and frozen foods. Companies with extensive process heating, evaporation and/or product refrigeration often have energy intensities near 20,000 kJ/kg. However, the majority of companies in the survey report energy intensities in the 10,000 kJ/kg range with energy costs about 5% of total manufacturing expenses.

This group's energy efficiency improved 3.8% during 1989, which

boosted the gain to 23.4% since 1985 and 32% since the original 1978 base year. Impressive gains have been reported each year. Interestingly, the pattern of concerns reported in this sector was more evenly balanced than shown in the aggregated table. This might be the result of more stable operating conditions and steady progress in energy management.

Companies in this group are rapidly installing the latest high-tech energy management controls, e.g. PLCs, and are reviewing their process technologies.

In the past ten years, the natural gas share has nearly doubled from 38-73% while heavy fuel has followed an opposite trend. Most fuel oil use now occurs only when natural gas service is interrupted.

The overall electricity share has changed little from 19-22% in recent years, even though several Quebec based companies report that it has been necessary to revert to fossil fuels. Hydro Quebec recently cancelled its Electric Boiler Incentive program because of low water levels. However, in some cases, they are paying customers to keep their electric boilers in standby condition.

Meat Packers

The meat processing industry continues to experience swings in operating efficiency, mostly because of varying production levels, changing government hygiene standards, company rationalizations and a slow rate of investment in new equipment. Recent performance has slowed or dropped as a result. Efficiency was down again by 1.3% in 1989. The greatest part of the overall 41.3% gain since the 1977 base year occurred before 1985 when significant plant improvements were made.

Meat packers have seen the largest proportional increase in electrical

use in the past ten years. This share has gone from 18% to over 30% of the total mix because of added refrigeration equipment, conservation efforts directed towards fossil fuels, greater automation, etc.

The status of energy management now is relatively low because of the overriding concerns for profitability, competition with larger U.S. companies and labour productivity. Participating companies report directing most of their efforts to "housekeeping" actions.

Poultry and Egg Processors

This sector includes a mix of poultry and egg processors, each with different energy requirements. For example, energy intensity for the egg and egg product processors average about 4500 kJ/kg while the poultry processors' average is 2630 kJ/kg of output.

Based on a smaller sampling of participants than previous years, energy utilization declined by 7% in 1989. Business volume was virtually the same as in 1988. However, this sector is the highest user of electricity at 44% of the total mix, and performance is therefore very susceptible to individual production swings.

In this group, concerns were generally rated higher than in other groups. This could be an indication of the "hands-on" style of management in these companies and the thin profit margins caused by tough competition. It is a reflection of such pressures which has led to the lowering of the overall efficiency gain to 8.2% since 1985. While housekeeping activities have provided the bulk of efficiency gains to date, some HVAC, lighting, and a few major heat pump installations have helped.

Plant energy use appears level but delivery truck fuel efficiency is still receiving attention. Nearly all the re

spondents gave energy management a higher priority than in the past.

Electricity is the dominant source of energy in this industry. Some Quebec plants are totally electric-powered. Elsewhere, plants get about one-half of their energy from electricity.

Sugar Refineries

During 1988, performance improved by an impressive 8.4%. This is greater than usual increase (normally averaging 4.3% per year) raises operating efficiency to 16.1% over the 1985 Base Year level and 4.4% over 1975 operating conditions. Industry-wide rationalization, follow-through on energy audits, investment in new equipment and closer attention to energy consumption have paid dividends.

Aggregated energy intensity for this homogeneous product now is down to about 3500 kJ/kg of output. With approximately 95% of total energy coming from fossil fuels, mechanical vapour recompression and greater heat recovery hold significant energy saving possibilities.

Some cogeneration is now done to help lower the electrical share to 5%. Raw sugar melting and slurry evaporation remain the largest part of plant steam loads.

Wineries

Canadian wineries have only recently begun reporting results. In 1989, the sector's energy needs were met principally by natural gas (58.6%) and electricity (29.6%). Compared to 1988, performance improved just under 1%. This sector has one of the lowest energy intensity levels with costs less than 1% of the value of shipments.

The sector's management concerns follow the general pattern for the industry. The potential attached to improved process technology was the lowest in all the groups, whereas refrigeration improvements apparently have the highest potential. In this industry, managers must live with their operation and can't afford to overlook the smallest detail.

Future Performance Outlook

The 31% improvement goal set for 1990 is achievable if normal performance returns to the 2.7% per

year average rate of gain. However, this is doubtful in view of declining profit margins, investment trends and capacity utilization rates. On the positive side, free trade is pushing companies to take a hard look at productivity problems.

The beverage sector is faced with the most acute problem. Its overall capacity utilization level of 61% is close to the low point of 58% experienced in the 1982-83 recession. The food sector's 1981 peak capacity utilization level of 84% has now declined to 79% which is also close to the 1983 low point. Meat plants in particular are affected by over-capacity while fish processing is suffering from a shortage of stock.

Capital spending is slowing from the high levels experienced in the 1987-88 boom period. Spending on new machinery and equipment increased 15% in 1987, 16% in 1988, and is now optimistically forecast at 12.5% for 1989 according to the latest Statistics Canada spending intentions survey. Less new equipment is being purchased and efficiency performance may suffer under tighter maintenance budgets that are not keeping up with the rate of inflation.

Table I

Food and Beverage Industry Group Energy Consumption, Performance, Costs, Savings

Sector	Base Year	Consumption Terajoules	1989 Eff. %	Total Eff. %	Estimated Cost (\$,000)	Annual Savings (\$,000)
Bakeries	1979	1,054	3.78	20.77	8,890	184
Biscuits	1979	1,067	-2.17	11.55	9,094	105
Brewers	1976	8,305	-5.90	3.35	68,555	172
Confectioneries	1981	1,426	-8.49	24.72	12,548	396
Distillers	1977	4,826	7.26	30.24	26,531	687
Fisheries	1978	1,346	-4.33	25.29	12,453	281
Grocery Products	1978	4,120	3.82	32.11	30,662	863
Meat Council	1978	3,740	-1.30	41.34	32,012	1,150
Poultry and Egg	1982	842	-7.01	3.53	9,800	49
Food Processors	1976	5,464	0.81	23.28	39,433	706
Sugar Refineries	1975	2,301	8.39	44.41	11,667	370
Wineries	1988	84	0.43	0.43	789	—
Totals		34,877	-1.69	27.01	262,439	4,967

Table II

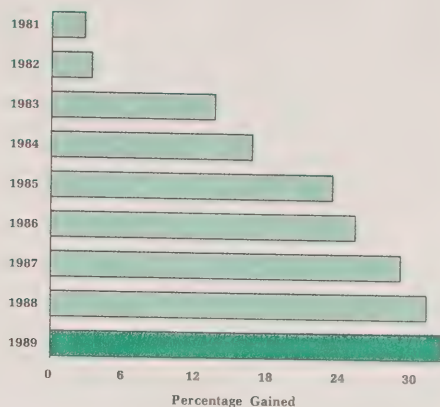
Food and Beverage Industry Energy Use and Efficiency

<u>Type</u>	<u>Units</u>	<u>Terajoules</u>	<u>Distribution %</u>		
			<u>1989</u>	<u>1985</u>	<u>1979</u>
Natural Gas	596,324,716 m ³	22,183	63.6	69.7	44.9
Electricity	2,120,801 MWh	7,635	21.9	18.6	16.9
Liquid Petroleum Products:					
#2 Fuel Oil	46,205 kL	1,802	5.1	1.2	2.7
#5, 6 Fuel Oil	71,455 kL	2,851	8.2	9.4	14.5
Diesel & Gasoline	2,902 kL	115	0.3	0.2	0.4
Steam		121	0.3	0.3	.6
Others Fuels:					
Propane, LPG	6,036 kL	160	0.4	0.2	0.2
Miscellaneous	—	10	—	0.4	0.6
1989 Total Consumption		34,877			
1985 Base Year Equivalent Consumption		36,902 Terajoules			
Efficiency Improvement 1977 to 1985	21.53%				
in 1986	1.24%				
in 1987	3.15%				
in 1988	2.78%				
in 1989	— 1.69%				
Total Improvement	27.01%				

General Manufacturing

Energy Conservation Task Force

Bent K. Larsen
Chairman



The energy efficiency survey is based on a diverse group of manufacturing companies that are members of The Canadian Manufacturers' Association (CMA). The participants have been segregated into categories according to their type of manufacturing technology and/or energy intensities. Though the sample is relatively small, the high quality and steady supply of broadly based information provides a good picture of general manufacturing conditions. Three-quarters of the participants spend more than one million dollars per year for energy and routinely practice effective energy management.

General Performance and Business Conditions

Aggregated energy efficiency slipped 0.4% during 1989, which lowered the overall gain to 8.3% since 1985 and 31.6% since the original 1980 reference year. The 1989 result is the first downturn recorded since monitoring began in 1979.

The surveyed group's estimated total cost of fuel and electricity amounted to nearly \$150 million during 1989. The average energy cost of \$7.50/gigajoule (GJ) was up sharply from \$6.56/GJ in 1988, mainly because of higher electricity costs in Ontario.

Consolidated energy shares for the group remained virtually the same as 1988 at 33.6% for electricity, 50.7% for natural gas, and 8.1% for petroleum products. Even with the slight decline in energy efficiency, additional cost savings were realized because of the higher energy prices and costs.

Energy performance suffered because of deteriorating business conditions through 1989 which caused a slowdown in production growth and a more conservative approach to investment spending. The bank prime interest rate rose to 13.28%, the Canadian dollar was pushed up to 84 cents U.S., corporate profits (before taxes) shrank 14.6% and capacity utilization declined from

90.8 - 89.4%. While the strong capital investment momentum in the entire manufacturing industry rose 8% during 1989, not all sectors, such as metal fabricating, enjoyed the same trend. Here, investment dropped 11% and is forecast to drop even more in 1990.

Continued soft energy prices did not stimulate increased performance during 1989 as in previous years. Shown in the accompanying graph, the motivation for improving energy efficiency is greatest when energy prices rise faster than product selling prices. This situation is expected to occur again in 1990 thanks largely to the impact of the proposed 7% Goods and Services Tax (GST).

The indices also show how electricity prices have steadily risen in comparison with deregulated natural gas prices, and how the steep drop in oil prices in 1985 helped lower the overall energy costs to industry. However, it is expected that oil prices will escalate again in 1990.

Manufacturers will have to intensify their Total Quality Control efforts even more to help offset this effect on increased energy prices. Because electricity is the most significant cost component, given its higher prices and large share of the total consumption, manufacturers should cooperate as much as possible with their local utilities' Demand-Side Management activities.

Total Quality Control

The surveyed companies were asked to rank the importance of selected components of their Total Quality Control programs to determine the relative importance of energy management. The selected items were categorized as: general concerns; future sources of improvement; and barriers to improvement.

Though the list is short and contains a mix of general (business) and specific (technical) issues, it does provide a valuable overview of where the manufacturing industry is devoting its attention. Government policy makers would do well to study these concerns and priorities.

Status of Energy Management

General Concerns

Product Quality	88.3
Safety & Health	84.1
Profit Improvement	82.9
Labour Productivity	80.6
Plant Equipment	68.2
Pollution	67.6
Energy Efficiency	62.9
Raw Material Prices	61.1
Training	55.3
R&D	37.6

Energy Improvement Sources

Monitoring & Control	64.4
Process Technology	62.5
Housekeeping & Maint.	58.7
Electrical Systems	52.5
Combustion Systems	51.5
Other Utilities	50.6
Buildings	50.6
Waste Heat Recovery	50.0
HVAC	41.8
Materials Handling	33.3

Barriers

Economic Payback	76.5
Other Priorities	56.5
Staff Limitations	56.8
Uncertain Business	52.9
Technical Constraints	52.3
Impact on Occupants	51.7
Government Incentives	51.1
Detailed Information	41.1
Impact on Product	37.6
General Awareness	28.8

Management must strategically proportion time and resources according to the needs of the company. The above general concerns show a distinct time-related bias where daily attention to product quality cannot be relaxed and long term activities, such as R&D and training, get only the residual attention. Relative costs, type of products, etc. undoubtedly also had an impact on ratings.

However, the mid-point rating given to energy efficiency is significant considering the importance of such factors as maintenance of product quality, safety and health considerations, and profits. Labour productivity continues to be a top concern because of the intense competition in today's free trade environment.

Recognition of the close linkage between energy use and control of the environment might also be inferred

from the given standings. Indeed, many companies have lumped these two activities together for joint improvement.

Improved monitoring and controls are seen as having the most immediate cost saving benefit and do not require large capital investment. Many of the surveyed companies are very labour intensive and use mature technologies that cannot be changed.

The highest-ranked barrier to improved performance was unacceptable financial returns. This was followed by uncertain business conditions, indicating management is becoming more cautious in their investment plans in view of rising interest rates and slower production. The lack of strong financial incentives and/or a supportive tax structure was also not helpful.

Group Trends

Rubber Products

Participation in this group has shrunk as a result of tough business competition, thin profits, and continuing rationalizations. Energy performance has also declined 2.5% during the year. Aggregate improvement has slid to 31.5% over 1972. However, while several old plants are being shut down, smaller new specialty plants are being built to serve niche markets.

Whereas other groups registered pronounced differences in plant management concerns and specialized sources of future improvement this group rated everything at higher level, suggesting their problems are more broadly based and much more acute.

The electricity share of total energy consumption has risen about 2% in the past six years to 35%

Natural gas provides 29% of the mix while nearly 35% comes from heavy oil.

Specialty Chemical and High Intensity Products

The companies in this group make a variety of energy-intensive products including sodium chlorate, fiberglass insulation, and specialty chemicals. Consistent tracking of participants' annual performances show efficiency has risen 5.4% during 1989. Overall performance is nearly 30% better than in 1978, helped considerably by one company's major process revision and by-product hydrogen burning operation last year.

Labour productivity, safety and health and product quality out-ranked energy concerns in this group, putting them almost on the same level as attention paid to overall profit improvement. The particular sources of future energy improvement and perceived barriers all varied widely because of the different processes and markets involved. The very high level of energy use "awareness" in these companies suggests that monitoring and general performance is not a problem.

Foundries, Forging, and Heavy Metal Operations

Companies reporting in this highly energy-intensive category had mixed efficiency gains resulting in a marginal improvement of only 0.2%. This leaves the aggregated improvement at 6.1% since 1985 and 12.6% since the original 1981 reference year.

This sector is more concerned about pollution, rising raw material costs, energy prices and process improvements than others in the survey. This anxiety is also shown in a higher than average effort to improve monitoring and control of combustion systems and a higher level of frustration shown in

overcoming technical difficulties and economic obstacles to improved efficiency.

However, innovative solutions are being introduced to solve some problems. For example, Environmelt Ltd. in Stoney Creek, Ontario, has recently started up a new foundry process where graphite is injected into the natural gas fuel to add carbon more effectively into the iron melt. This "cokeless cupola" process, it is claimed, creates a pollution-free operation and results in significant increases in productivity.

Other efforts to change technologies, e.g., mechanical attrition and thermal reclamation of casting sands, a shift to induction melting in the foundry sector, oxygen enriched furnaces in forging companies, more heat reclamation in most sectors, etc. have also helped to contain rising energy costs.

However, the share of expensive electricity continues to rise slowly and is now 35% of the overall energy used. The natural gas share has remained level at 48% while consumption of coal and wastes at 12% and fuel oil at 5% have slowly decreased.

Cheap and plentiful natural gas remains the best fuel where continuous heating is required while induction melting offers advantages in operations that are intermittent. Companies are monitoring electrical demand more closely as this cost component is rising rapidly because of broader application of Time-Of-Use (TOU) rate structures.

The two key factors that mitigate against large investment in energy improvements in the mature metals industry are technological obsolescence and production decline. The foundry business, for example, has seen a general 2% volume decline from 1975 to 1985 and twice this rate in the past four years. Increased

foreign competition, material substitutions, design changes, etc. have exacerbated the problem in all sectors.

Light Manufacturing

These companies have had steady energy efficiency improvements of 3.4% in 1989 and 4% in 1988. Aggregate gains have reached 13.1% since 1985. In this group, electricity has always provided 25% of the power and natural gas 70%.

The steady energy performance gains reflect the intense efforts at Total Quality Control. Companies operating in this labour-intensive industry are very much exposed to international competition and must substantially improve to survive. Product quality, labour productivity and training had the highest plant management concern ratings. In the past the efficiency emphasis was directed to product and plant rationalization. Aggressive companies like Bombardier Inc. in Montreal have invested heavily in new product development and have expanded into world markets.

Energy efficiency outranked pollution on the rating scale probably because energy improvements are still seen as having a direct economic return on investment. In a recent CMA general survey, only 11% of the respondents ranked the environment as the issue of first or second importance for federal government action.

Regarding future sources of energy improvement, even though there were considerable differences in this group, companies are now placing more emphasis on plant utilities than on processes and more effort on people related solutions than on capital expenditure solutions, i.e. training and maintenance rather than heat recovery for energy improvements. It is expected this trend will continue into the foreseeable future.

Figure I

General Manufacturing Energy Costs vs Value of Shipments Manufacturing Sector

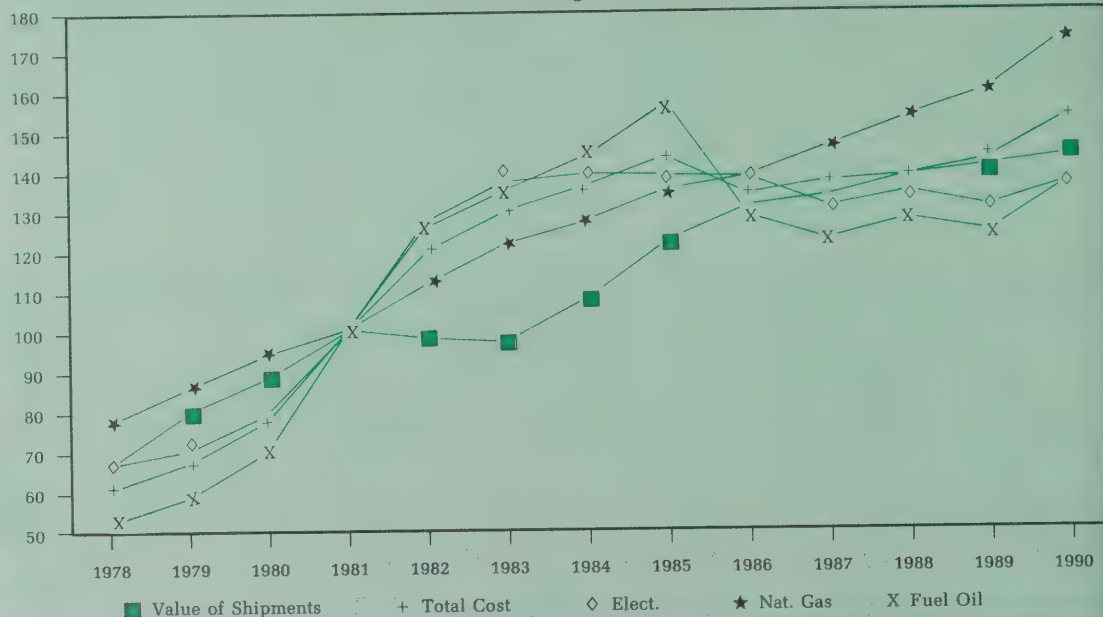


Table I

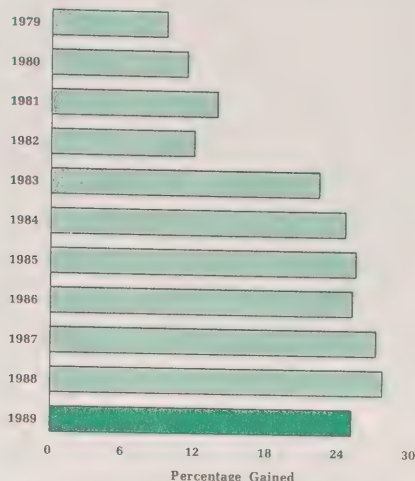
General Manufacturing Industry Energy Use

Type	Units	Gigajoules (10 ⁹)	Percent Distribution		
			1989	1987	1985
Natural Gas	284,363,290 m ³	10,578,319	50.7	51.7	60.2
Electricity	1,947,853 MWh	7,012,272	33.6	37.6	28.1
Liquid Petroleum Products:					
#2 Oil	6,778,735 L	264,370	1.3	0.2	1.2
#6 Oil	32,376,378 L	1,265,700	6.0	8.8	9.6
Diesel	2,659,878 L	106,129	0.5	0.6	0.4
Gasoline	1,805,591 L	65,362	0.3	0.5	0.1
Other Fuels:					
Propane	8,253,324 L	219,538	1.0	0.3	0.3
Steam	n/a	36,400	0.2	0.2	—
Others	n/a	1,288,950	6.2	0.1	0.1
Totals		20,837,031			
1985 Base Year Equivalent Consumption:		22,719,031 Gigajoules			
Energy Efficiency Gain between 1981 and 1985:		23.4%			
1986:		1.9%			
1987:		3.8%			
1988:		3.0%			
1989:		-0.4%			
Total Energy Performance Improvement:		31.7%			

Industrial Minerals Industry

Energy Conservation Task Force

John M. Lind
Chairman



Sector Description

There are nine sectors in the Industrial Minerals group that mine, process and manufacture a variety of non-metallic products for use in construction and other manufacturing industries. The value of shipments from this group amounted to \$7.6 billion in 1989.

The energy consumption and trends shown in this survey represent about 85% of the total industry performance. Approximately 90% of the gray cement producers, nearly three-quarters of the ceramics industries, abrasives, clay brick and tile, glass and refractory producers are included. Half of the lime producers and about 10% of the diverse concrete product manufacturers usually participate. The reporting population in this voluntary program is slightly down from previous years due to added business pressures. However, the group's total representation went up because of the inclusion of one large integrated company in the miscellaneous minerals sector.

Improving energy efficiency is an important goal throughout this industry because of the high energy intensities and large cost budgets.

For example, the lime sector spends 35% of its manufacturing expense on energy, the cement sector allocates 25%, while the clay products, abrasives, glass and refractory industries operate in the 10 - 20% range. Continuous efforts are being made to reduce these costs. Higher operating efficiencies are also seen as the most practical and economic means of reducing the emission of "greenhouse" gases.

General Performance and Conditions

While the cement manufacturers reported no change in performance in 1989, four sectors showed gains and four had lower efficiencies. The aggregate result, as shown in Tables 2 and 3, was 2% lower for the year. This leaves the operating efficiency at nearly the same level as the 1985 reference year, but 25.4% better than the original 1975 base year energy intensities.

More importantly, estimated total energy cost would have been \$176 million higher without the reported overall efficiency gains.

There are no apparent common business or technical reasons for the

efficiency decline. Those sectors affected by a slowdown in construction markets, i.e. cement, concrete products, clay brick, and to some extent asbestos and glass, had mixed performances. Companies selling products to the steel and automotive markets also had opposing results. In the dominant cement industry, which accounts for over half the group's consumption, efficiency was at the same level as 1988 in spite of a 4% decline in production. The large glass industry also saw a decline in output and a subsequent loss of operating efficiency. Total investment in new construction and equipment, after adjustments for inflation, was at the same level as 1988. However, more went into new capital equipment (8%) and less into maintenance (-2.3%).

This year, members of the group were asked to rank the priority of selected items impacting on energy efficiency, the most likely sources of improvements, and some of the barriers that will affect future performance. While the list is not exhaustive, it nevertheless paints a good picture of current operating conditions throughout the industry. This list is presented below.

Status of Energy Management

Plant Priorities

Safety & Health	90.0
Product Quality	87.8
Profit Improvement	87.2
Pollution Problems	81.7
Labour Productivity	78.3
Energy Efficiency	76.1
Plant Reliability	71.7
General Cost Control	71.1
Training	58.9
R&D	44.4

Improvement Sources

Process Technology	78.8
Combustion Systems	75.2
Electrical Systems	71.3
Monitoring & Control	67.0
Maint. Procedures	54.0
Waste Heat Recovery	49.4
Materials Handling	45.3
Buildings	36.7
Air Comp. Systems	36.0
HVAC, Refrigeration	14.7

Barriers

Economic Payback	76.2
Business Conditions	73.1
Lack of Incentives	67.7
Technical Difficulties	56.9
Other Priorities	51.7
Staff Capabilities	50.0
Impact on Product	49.2
Analyzed Opportunities	37.5
Impact on Personnel	34.2
Awareness	33.1

The high priority given to energy efficiency suggests the flat performance in 1989 is only a temporary setback. Companies are planning an increase in energy conservation efforts because of growing emphasis on environmental controls, energy costs (especially electricity) that are escalating faster than normal and declining profit margins.

It is worth noting that in 1991, energy prices will be pushed up 7% more by the Goods and Services Tax.

There is a strong consensus that continued energy improvements will come mainly from improvements in process technologies, combustion systems, electrical systems, monitoring and controls, maintenance (housekeeping) techniques, and further recovery of waste heat. Though the basic technologies used throughout this industry are very mature, there is room for improvement in existing process equipment and production techniques.

The highest-ranked barrier to improved performance was unacceptable financial returns. This was followed by uncertain business conditions, indicating management now is more cautious in investment plans because of rising interest rates and slower production. The lack of strong financial incentives and/or a

supportive tax structure was also considered a barrier.

Many retrofit projects are not implemented because of the enormous technical difficulties involved and built-in plant and operating constraints. Companies' firm commitment to a lean staffing mode may explain the slow progress, even while there is no shortage of improvement ideas.

Energy Use Trends

The patterns of consumption and substitution of fuels have been mixed because of technical constraints in each sector, plant locations, relative costs, etc. Current patterns and some of the more significant changes have been noted below. The group's overall trend is shown in Table 2.

These energy substitutions have had a noticeable impact on allocation of energy budgets. While the group's proportion of electricity use has been only 2% since 1979, its share of total cost has risen 15%. At current prices, this translates into about \$54 million being redirected to electricity. This situation now is a major concern to companies in electricity-intensive sectors, particularly the abrasives and refractory manufacturing operations where electrical costs are regularly

compared to those of foreign competitors.

Since 1979, there has been only a 6% share reduction in natural gas use. However, the large drop in de-regulated prices has resulted in a saving of \$37 million among participating companies. Nevertheless, natural gas is still the dominant fuel in the industrial minerals industry.

Driven by government substitution incentive programs and concerns about availability, the decline in fuel oil consumption proceeded faster than falling prices. Between 1979 and 1988, the fuel oil share dropped from 27% to 8% of total energy while the proportion of total cost declined from 28% to 11%. In so doing, some \$41 million was trimmed from this category in overall energy budgets. The slow rate of decline in the fuel oil share now appears to signal that a new economic balance point has been reached.

Coal has had a major impact on reducing the consumption of fuel oil as well as a minor effect on natural gas. During the 1979 to 1988 period consumption of coal has more than doubled from 16% to 36%, but its percentage of total energy cost has risen only from 6.7% to 10.8% in the surveyed companies. As a result an additional \$13 million has been shifted to coal.

It is difficult to generalize on the impact of capital spending on energy efficiency because of the vast differences in capital and energy intensities, rate of spending, etc., in the various sectors. However, it is surmised the impact of annual spending on new machinery, growing from \$193 million in 1985 to \$359 million in 1988, has helped raise production capacities far more than energy efficiencies. Early indications of slower future capital spending and the prospect of lower capacity utilization rates does not appear supportive of continued energy efficiency improvement.

Sector Reports

Aluminas

Efficiency increased because of higher capacity utilization and minor changes in product mix. It has also been possible to revise some furnace operations to reduce heat losses and provide recovery of waste heat to preheat raw materials.

The energy intensity of silicon carbide production varies between 2,000 and 14,000 megajoules (MJ) per tonne of product, depending on the size and configuration of the donut shaped resistance "furnace" used in this process.

About 88% of total energy is applied by electricity. The remaining 12% comes from natural gas used for emission cleanup. Heat captured from the raw material coke does not enter into efficiency calculations.

Raw aluminum oxide is made by fusing chemically purified alumina with fluxing agents and other admixtures in conventional electric arc furnaces. The electrical intensity of this process is about 10,000 MJ per tonne. Studies are now being conducted into the arcing stability of the carbon anodes as well as further optimization of the fluxing current.

Asbestos

Asbestos mining and refining is a moderately energy intensive process amounting to 6500 MJ/tonne of product. The British Columbian company is totally dependent on distilled fuel oil for its energy needs, including generation of electricity for the mill and town site. The Quebec companies obtain about 35% of their energy from electricity, 42% from residual fuel oil and 23% from other refined petroleum products used for vehicles and other miscellaneous purposes. Energy costs still amount to about 20% of the total manufacturing expense.

After several years of declining markets and business rationalization, total production output has stabilized. The group's performance dropped somewhat because one Quebec company was in the final stages of an expansion project. Investment in new construction and machinery and equipment in 1989 was up 10.5% over the 1988 expense of \$101 million but is forecast to fall back to the 1988 level next year.

Cement Manufacturing

Increased efficiency in some dry process plants was completely offset by reduced performances elsewhere because of a 4.1% cutback in production.

Dry plants (without preheaters) managed to reduce energy intensities from 4620 to 4567 MJ/tonne. In dry plants (with preheaters), intensities went up from 4598 to 4697 MJ/tonne. Wet plant intensities rose from 5777 to 6132 MJ/tonne because of a large drop in capacity utilization. As a result, overall performance is nearly the same as recorded in 1985, but 23.8% better than 1974 base year levels.

Based on the \$197 million estimated cost of fuel and electricity, the level of annual savings amounts

to \$61 million per year in the surveyed companies.

While significant fuel shifting took place in 1989 from natural gas to coke, the share of electricity and fuel oil remained much the same. Since 1985, the natural gas share has steadily dropped from 29% to 24.8% of total energy consumption. The coal share remains at 45.6%, but coke usage has increased from less than 10% to 14.7%. Electricity remains at 11.6% of the total while the fuel oil proportion is now down to 3.2%.

Clay Brick, Tile, and Clay Products

Group energy efficiency was down marginally because of an industry wide 13.7% decline in capacity utilization. However, some companies reported productivity gains due to fewer equipment problems and a general effort to become more competitive in the free trade environment. The majority of the companies surveyed forecast that efficiencies will rise next year for a variety of technical and business reasons.

The energy intensity of clay brick production varies between 3500 and 4000 MJ/tonne (1.8 tonnes/1000 equivalent units) depending on the properties of raw materials used. The energy intensity of short run clay tile producers is nearly three times this amount. Energy costs often compose up to 25% of total manufacturing expenses.

The greatest amount of conservation effort has gone into furnace design, replacement and control of burners, heat recovery, and production scheduling. Electrical efficiencies are still commanding attention because of the variable demand and, now with lower production levels, the declining load factors.

Throughout the surveyed group, natural gas provides nearly 93% of total energy while electricity supplies most of the remainder.

Little propane and fuel oil are reported for use in plant vehicles. The cost of electricity amounts to one-quarter that of natural gas.

Concrete Products

The concrete products sector is a diverse manufacturing group that makes concrete blocks, sewer casings, precast slabs, and a host of miscellaneous products for the construction industry. Even though the energy-intensity of the products is relatively low, the reported high priority given to energy efficiency and annual energy expense ranging up to \$750,000 in the surveyed companies suggests that energy management is a primary concern. Energy costs average 5-8% of total manufacturing expense in this sector.

The 2.7% efficiency gain reported in 1989 was due primarily to a 4.7% rise in production. The most common product, concrete block, still requires 350 to 500 MJ per tonne (10 to 12 MJ/equivalent unit) of output. Considerable variation exists because of the type of curing systems used, degree of dryness tolerated, strength of admixtures, etc.

Nearly 70% of the energy share is provided by natural gas and less than 6% from electricity. All the remainder is diesel fuel used by yard vehicles.

Glass

The companies in this group operate 19 large continuous glass making plants which produce about 90% of the glass containers, flat glass and fibre insulation used in Canada. Glass making is an energy-intensive operation requiring about 4.7 gigajoules per tonne for the melting operations alone.

Annual efficiency has varied since 1985 but is still nearly 35% better than 1974 base year operating conditions. Growing international competition, introduction of the government's Container Act policies, merger of two of the largest container companies, increased re-

cycling of used glass (cullet), and reduced rate of investment leading up to 1989 have affected current operating efficiencies.

Since monitoring began in 1978, the share of electricity has doubled from its 9.4% level. Some companies have added electric "booster" heaters to their furnaces to increase production. Over the same period the share of natural gas has declined from 84% to just under 77%. Use of other fuels has remained about the same.

Lime

Companies in this group make various grades of lime and cement, as well as dolomite products for fluxing, refractory and chemical use. Lime, made by calcifying quarried limestone at 2650° F in rotary kilns, has an energy intensity of about 6300 MJ/tonne. Energy accounts for nearly 40% of total manufacturing expense, making it one of the most important elements of plant cost.

The large gain in operating efficiency in 1989 is the result of several technical improvements and management's intensive effort to raise overall productivity. Kiln operation continues to be the focus of attention because nearly 50% of the heat content of the fuel (2800 BTU/100 pounds of raw material feed) exits the stack at about 800° F.

While some lime kilns can be fired with coal or coke, natural gas is the preferred fuel when high product purity is essential. Since monitoring began, the electrical share has remained at 6% but the natural gas share has varied between 50-65% depending on the mix of reporting companies and competitive price of coal and coke. Use of fuel oil has been reduced from 32% to almost nil since 1979.

Miscellaneous Minerals

This dissimilar group of companies produces a variety of products such as: matte (impure fused materials

consisting of metal sulphides), silica sand and nepheline for glass making, raw crushed limestone and gypsum products, roofing granules and sodium sulphate. Many of these batch processes require extensive crushing and pulverizing, milling, refinement, drying and grading.

The processes are heavily dependent on electricity (57% in the 1989) moderate users of natural gas (35%) for drying, and the remainder is composed of back-up and vehicle fuel oil.

The greatest number of electrical service interruptions and power quality problems was reported by this sector. This may be due to the remote locations of most of the companies, which means utility distribution systems are showing increasing signs of overload. The growing number of outages affects plant operating efficiencies negatively.

Refractories

Manufacture of fired refractory products is akin to clay brick production except that energy intensities are much higher-in the 6500 MJ/tonne range-and costs usually amount to 40% of the manufacturing expenses.

It is difficult to aggregate the data yet protect the confidentiality of individual information because of the great diversity of products, difference in raw materials, and curing temperatures. No identifiable reasons are evident for the decline in energy efficiency.

In general, electricity still provides about 16% of total energy with the balance from either natural gas or heavy fuel oil, depending on the location of the company. Combustion systems, materials handling improvements, and process technology are the key areas that dictate energy management attention.

Table II

**Industrial Minerals Industry
Energy Consumption and Cost**

<u>Sector</u>	<u>Base Year</u>	<u>Consumption Terajoules</u>	<u>1989 Eff. %</u>	<u>Total Eff. %</u>	<u>1990 Target %</u>	<u>Estimated Cost (\$,000)</u>	<u>Annual Savings (\$,000)</u>
Abrasives	1982	3,198	4.02	14.47	20	37,465	6,336
Asbestos	1979	4,747	- 6.17	9.69	10	36,323	3,895
Cement	1974	52,886	0.00	23.79	40	197,511	61,651
Clay Brick	1978	3,450	- 1.54	26.38	40	15,843	5,677
Concrete Products	1979	611	2.73	18.67	20	3,429	787
Glass	1974	18,423	- 1.03	34.94	50	113,523	60,977
Lime	1979	6,008	5.00	22.86	25	36,557	10,832
Miscellaneous Min.	1977	6,652	0.57	12.37	15	71,337	10,067
Refractories	1975	978	- 4.60	5.87	15	5,198	324
Totals		96,956	- 1.96	25.74	35	517,189	179,862

Table III

**Industrial Minerals Industry
Energy Use and Efficiency**

<u>Type</u>	<u>Units</u>	<u>Terajoules</u>	<u>Distribution %</u>		
			<u>1989</u>	<u>1985</u>	<u>1979</u>
Natural Gas	1,034,937,773 m ³	37,521	38.7	42.6	44.9
Electricity	5,058,648 MWh	18,207	18.8	15.6	13.9
Liquid Petroleum Products:					
#2 Fuel Oil	14,955 kL	574	0.6	1.2	2.7
#6 Fuel Oil	93,754 kL	3,817	3.9	5.1	14.5
Diesel & Gas	56,184 kL	2,227	2.3	2.2	7.4
Coal & Coke	12,203,600 Tonnes	33,437	34.5	32.4	15.8
Other Fuels:					
Propane, LPG	10,801 kL	284	0.3	0.2	0.2
Wastes	—	885	0.9	0.7	0.6
1989 Total Consumption		96,956			

1985 Base Year Equivalent Consumption = 93,349 Terajoules

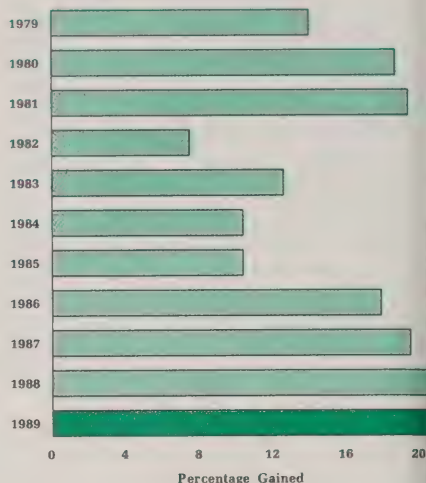
Efficiency Improvement to 1985 = 25.4%
 in 1986 = - 0.3%
 in 1987 = 2.0%
 in 1988 = 0.6%
 in 1989 = - 1.9%

Total Improvement = 25.8%

Machinery Industry

Energy Conservation Task Force

Frank A. Hlohovsky
Chairman



Task Force Description

The machinery industry companies represented in this section of the report are member firms of the Machinery and Equipment Manufacturers' Association of Canada (MEMAC). MEMAC members are Canadian manufacturers of a wide range of machinery and equipment used in the resource, energy and process industries — from mining, pulp, paper and printing equipment to cranes, conveyors, gears, pumps and valves. The majority of firms are of the low energy intensity type, generally in fabrication and assembly operations. However, they supply the most energy intensive industries (mining, pulp, paper and petroleum) and have a significant impact on the quantity of energy consumed per unit of production or activity.

The survey covered approximately 100 firms. The majority are located in Ontario and Quebec. The participation level, however, was a disappointing 25%.

General Performance and Progress

In 1989, participating MEMAC members achieved a 1.6% net improvement in energy consumption relative to 1985. Compared to the original base year, the improvement is 23.1%.

As in previous reports, the absolute value of improvement must be used with caution, particularly when using the base year. There has been a great deal of rationalization in the industry as well as a trend towards sub-contracting of higher energy intensity activity. It is considered that either or both of these factors have caused a distortion in the absolute improvement values. Member firms are fully committed to reducing the rate of energy consumption in their manufacturing activities and that is the most important factor.

Future Outlook and Concerns

Environmental concerns have contributed to a heightened awareness

in all industries of technologies available for energy conservation. Two examples are improved efficiency electric motors and improvements in tribology. This awareness will be exploited to motivate the demand side, particularly the resource industries, to choose the most energy efficient machinery and equipment when undertaking capital investments or retrofits.

The industry will continue to participate in Ontario and Quebec government initiatives in energy management and promote Quebec and Ontario Hydro programs.

The MEMAC task force believes that the environment is an issue for the 1990's and that energy efficiency improvements will contribute not only to resolving problems for a cleaner environment but also to improving the industry's competitive position.

Table I

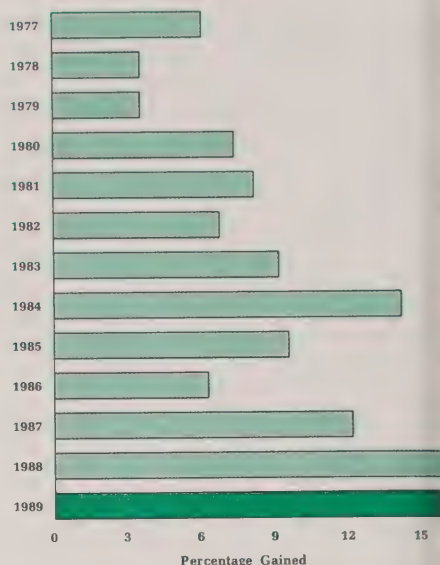
Machinery Industry Energy Use and Efficiency

<u>Type</u>	<u>Units</u>	<u>Gigajoules</u>	<u>Distribution %</u>	
		<u>(10⁹)</u>	<u>1989</u>	<u>1985</u>
Natural Gas	8,427,137 m ³	313,488	52.5	44.3
Electricity	47,217,704 kWh	169,985	33.9	35.1
Liquid Petroleum Products:				
Distillate Oil	223,878 L	8,731	1.7	5.6
Diesel	8,365 L	326	0.1	0.1
Gasoline	98,397 L	3,562	0.7	0.6
LPG	167,952 L	4468	0.9	1.1
Other Fuels:				
Propane	31,616 L	857	0.2	0.3
1989 Total		501,417		

Mining and Metallurgy Industry

Energy Conservation Task Force

Paul B. Batten
Chairman



Task Force Description

The mining industry is the fourth largest industrial consumer of domestic energy in Canada. The entire industry consumed 266 petajoules (PJ) of energy in 1989 – 12.7% of the total industrial use and 3.3% of the total domestic demand.

The Mining and Metallurgy Energy Conservation Task Force was organized in 1975 and is operated under the auspices of the Mining Association of Canada (MAC). Participants include the major Canadian producers of basic metals and ores, uranium, potash, coal, synthetic oil and fertilizers. A number of energy-intensive processes are used including mining, milling, smelting, in-durating and refining.

Sixteen major integrated companies participated in this survey. These companies operate a total of 37 sites in addition to the associated processing operations. Based on output figures and energy consumption data, it is estimated that 80% of the Canadian mining industry output, excluding asbestos mining and quarrying operations, is covered in this survey.

The task force continues to promote energy efficiency through technology transfer activities and by providing technical seminars and case study information to its members. Activities in 1989 included a special seminar on energy technologies at the Ortech International facilities in Mississauga and involvement in the Laurentian University seminar on Energy Efficient Technologies in the Mining and Metals Industry. Other activities include promotion of a new western branch in British Columbia and Alberta where over half the industry is located (11% of the industry is located in Saskatchewan, 13.5% in Ontario and 8.4% in Quebec).

Performance

The participating companies had an aggregate 3.6% improvement in energy intensity during 1989 which boosted the total gain to 19.6% since the consolidated 1973 reference year. With the strong recent performance and having already surpassed the 1990 performance goal of 15%, a revised target of 25% has been set.

Energy cost savings of \$29 million were achieved during 1989, based on the gain in operating efficiencies and the estimated \$1 billion in purchased cost of fuel and electricity. It is estimated the average cost of energy used was about \$7.40 gigajoule (GJ) throughout the industry.

The mining industry's energy performance since 1978 is displayed in Figure 2 to demonstrate the impact of certain key operating and business factors on energy utilization. It shows that energy efficiency in this industry is mostly influenced by changes in capacity utilization, indirectly affected by changes in production and affected least of all by the amount of investment in new equipment and machinery. The impact of investment is low because of the time lag in (monitored) benefits from new equipment and the low percentage of designated investment used to reduce energy costs. In a special study by Statistics Canada it is estimated that less than 5% of total spending has an impact on energy efficiency whereas the general manufacturing industry is spending only 1% of its capital budgets on energy retrofits. Twice as much is

spent on environmental improvements as energy projects. The graph also shows that the energy efficiency trend is more stable than other related variables. Operating efficiencies, including energy utilization, often become the main focus of attention in a down cycle and are helped when the most inefficient mines are closed.

The relationship between energy utilization and capital investment is becoming an important consideration not only because of its impact on energy efficiency, but also its effects on environmental protection since these two subjects are very closely linked. This relationship is now being studied by government policymakers who have already opened discussions on this matter with task force representatives.

Capital investment in the mining industry fell again this year after reaching a peak in 1988, when profits were at their highest level in over a decade. Profits slipped 1% in the integrated sector, 47% in the "general" category, and 927% in the gold mining sector. Investment in new equipment fell 14% to \$2.7 billion. Traditionally the mining sector spends 26% of its investment on new equipment while a greater portion (31%) is used for repairs and maintenance.

Capacity utilization (which Statistics Canada now weights to reflect the technological effects of capital investment), fell 3.5% during 1989. The gold mining sector was particularly affected.

In Canadian operations, open pit mining techniques are generally used three times more often than underground mining methods. Open pit operations, excluding smelting and refining activities, now use between 18 to 36 megajoules (MJ)/tonne of output. For underground methods, energy usage amounts to \$9 to 180 MJ/tonne depending on the product, location, age and a host of operating factors.

In large mine operating budgets¹, electricity accounts for 6%, fuel 2%, labour has the largest share at 41%,

supplies amount to 21%, and 29% is allocated to depreciation, amortization, administration and other miscellaneous expenses.

Energy Use Patterns

Energy consumption by participating companies in 1989 amounted to 142,870 TJ, but with 8,121 TJ transfer and use of refinery off-gases and by-products, purchased energy amounted to 134,749 TJ. Figure 3 shows the general shift in energy shares since task force monitoring began in 1978. While the mix of energy sources reported has been affected somewhat by changes in the reporting population and the dynamics of sectoral production volumes, in general there has been slightly more growth in electricity use than shown. This trend has been evident from the individual company surveys.

Because electricity is the largest energy cost component, its use is closely monitored and efforts are being made to use it more effectively. In the article cited above, 29% of mine site electricity is used for ventilation, 11% for pumping liquids, 30% for compressing air, 12% for hoisting, and 18% for miscellaneous surface and underground services.

Within the mining sector, electricity distribution varies considerably, as shown from task force figures and a study² of more detailed consumptions.

Attention is currently being focused on specific areas where energy consumption is high.

In small mining operations, it has been estimated that energy comprises approximately 30% of total costs. Research into new furnace designs has been the subject of several ongoing projects jointly sponsored by government and industry. The new Lakeview TGS Electric Furnace

Pilot Plant Facility, operated by Ontario Hydro Research Division, has been set up to study smelter configurations and fuel sources. One of the first projects scheduled is in conjunction with Falconbridge Ltd., to explore methods of overcoming metallic build-up inside furnaces as concentrated roasting heat is increased, an action that will reduce SO₂ emissions.

Other electrical saving techniques discussed at a recent Ontario Ministry of Energy/Canadian Committee on Electrotechnologies seminar included electrical peak shaving methods such as using a site's emergency standby generating equipment. Falconbridge's Onaping area Energy Monitoring Project, a complicated network linking five sites together, typifies the intense efforts at reducing electrical consumption.

Future Outlook

While 1989 was the third year of impressive gains in energy efficiency since 1985, it is generally acknowledged that the mining industry must accelerate introduction of new technologies to maintain its prominence in world markets. Too often, only the large well established companies are able to invest in R&D and technical improvements. Junior companies still tend to use relocated equipment and outdated processing technologies.

Promising new techniques are now being developed that could have widespread use. These include use of ultrasonics to weaken rock and ease blasting and ventilation requirements, further development of electric vehicles to minimize mine pollution and HVAC, television monitoring of separation tank surface bubble sizes and colours to provide on-line optimization of flocculation systems, etc. Other developments being tried include autoclave

¹ Mine Energy Usage, (Copper Cliff South Mine), Ed. Sirkka, Inco Limited, Symposia on Energy Efficient Technologies in the Mining and Metals Industry, 1989.

² Acres Consulting Services Ltd., "Ontario Industrial Energy Demand Study", Ontario Ministry of Energy, 1980.

oxidation techniques in the gold mining sector to oxidize sulphide ore and improve gold recovery.

As for future business prospects, little growth is expected in the use of common minerals because of shifting public attitudes. Increased recycling, reusing and recovering reduce demand for basic materials. Following the oil shocks of the 1970s and 1980s, a thriving industry of new synthetic materials developed,

particularly in the U.S. and Japan. This trend to synthetics is expected to continue. The Canadian mining industry will have to respond to these trends with greater efficiencies, as ore bodies become less rich and more remote. The imposition of tough new environmental standards will add to the cost of doing business.

In spite of the forecast economic turndown in 1990, the task force's

performance goal of 25% total improvement can be achieved. This should happen not only for technological reasons, but also because of the shutdown of marginal operations and intense efforts at controlling operating costs.

Figure II

Mining and Metallurgy Industry Historical Energy Distribution

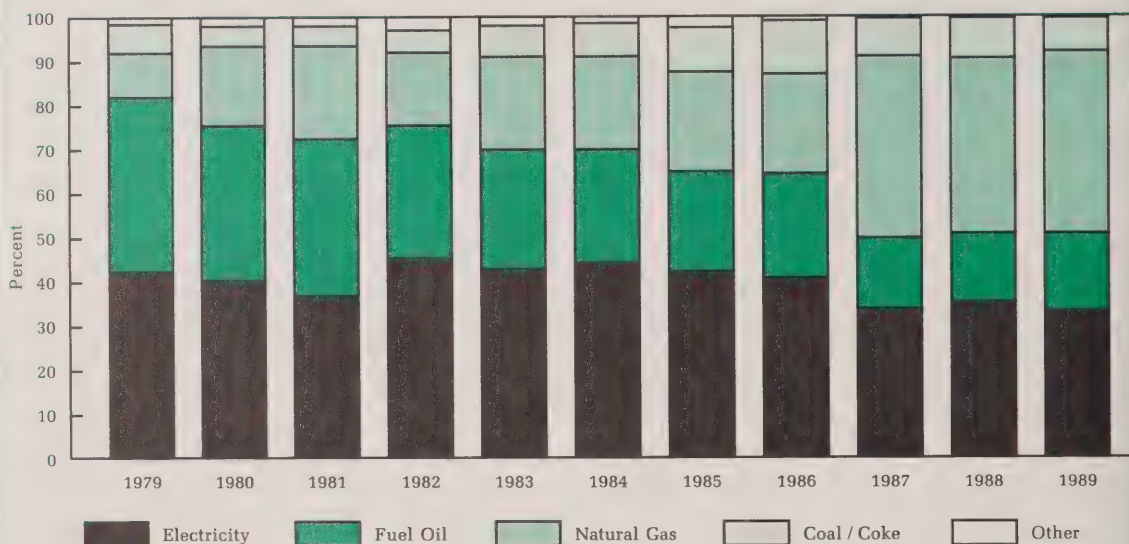


Table III

Mining and Metallurgy Industry Energy Efficiency Improvement

Current year (1989) total energy inputs	164,290 terajoules
Base year (1985) equivalent energy inputs	181,918 terajoules
Adjustments (1985-1989)	626 terajoules
Net Improvement	= 10.6%
Efficiency gain 1973 - 1985	9.6
1986	-3.3
1987	6.0
1988	3.7
1989	3.6
Total gain 1973 - 1989	19.6%

Figure I

Mining and Metallurgy Industry Energy Performance Versus Main Operating Factors

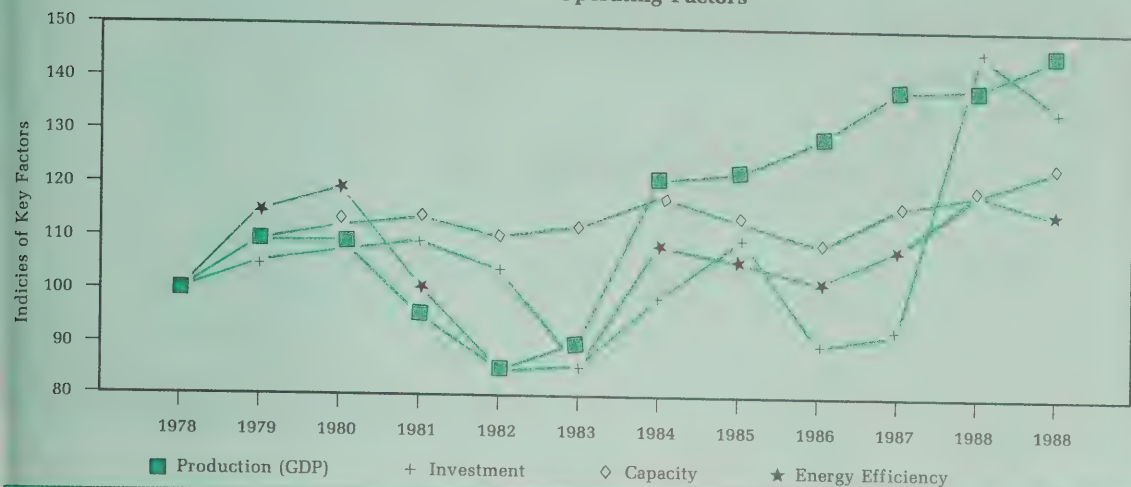


Table IV

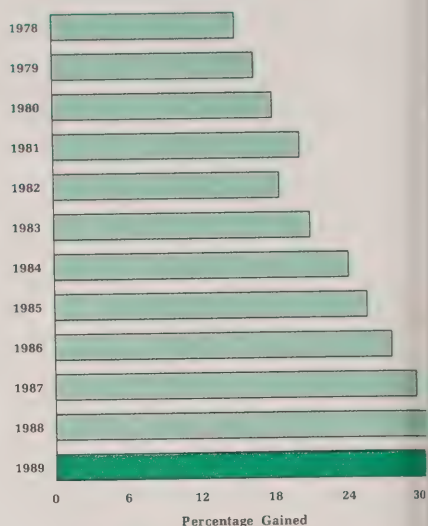
Mining and Metallurgy Industry Energy Use

Type	Units	Terajoules	1989	1985	1980
Natural Gas	1,465,940,000 m ³	54,533	38.1	23.1	18.6
Electricity	11,786,388 MWh	42,431	32.1	41.2	39.6
Liquid Petroleum Products:					
Distillate Oil	179,230 kL	699	0.6	4.4	6.1
Residual Oil	244,728 kL	10,352	8.4	15.6	27.1
Diesel	232,807 kL	9,289	7.6	4.0	2.1
Gasoline	11,935 kL	432	3.5	0.3	0.3
Coal	211,931 tonnes	6,803	3.6	4.9	2.0
Coke	233,347 tonnes	5,437	5.3	5.0	2.5
Other Fuels:					
Propane, LPG	32,330 kL	860	0.5	2.1	1.2
Others (hot water, steam)	n/a	33,439	0.2	0.2	0.5
Totals					
	1989	164,290			
	1988	135,265			
	1987	133,146			
	1986	98,796			
	1985	119,698			

Petroleum Refining Industry

Energy Conservation Task Force

Glen G. Myers
Chairman



The Petroleum Refining Industry Task Force, established in April 1977, is continuing to report on energy conservation progress in its sector. This report for 1989 is based on submissions from ten companies which process in total about 90% of the crude oil upgraded and refined in Canada.

Major changes in the industry and in the energy monitoring facilities in use have made it necessary to adopt a more recent base year to accurately quantify recent improvements in energy consumption. The year 1985 has been selected as the new reference. For consistency, the energy reduction since 1985 has been added to the 25.6% reduction achieved during the period between the original base year (1972) and the new base year.

Energy Efficiency Improvement Progress

In 1989, the petroleum refining industry achieved a 7.0% net reduction in energy consumption relative

to 1985. Compared to the original base year of 1972, the improvement is 32.6%, surpassing the 1990 goal of 30%.

The improvement was achieved in the face of a steady increase in processing intensity resulting from such factors as continued lead phasedown, increased product desulphurization requirements and further product mix changes. Without adjustment to equivalent 1985 operating conditions, the reduction achieved since 1985 was -1.3%.

Economic Factors Affecting the Industry

Almost all of the major energy conservation projects derived from process studies conducted in the early 1980s have been completed and few capital projects are planned for implementation in the near future. Instability of crude oil and product prices is continuing to complicate investment decisions regarding energy conservation and other projects. As a result, additional near term reduc-

tions in energy use will likely come from small investment projects and improvements in control and optimization of present facilities.

Any additional processing facilities needed to meet new government regulations will be designed for high energy efficiency, but will consume some additional energy, and will limit the funding available for other projects, including energy conservation projects.

Specific Conservation Activities

1. Operations and Maintenance: The reduction in energy use achieved in 1989 resulted partly from recently completed projects and partly from continued improvement in operating and maintenance practices. Energy conservation equipment installed in the mid-1980s reached the time of requiring additional maintenance and tuning. Areas of improvement included:

- Close attention to process settings by operators, supervisors, engineers and management;
- Increased direct responsibility for achieving conservation goals assigned to operators and maintenance workers;
- Continued emphasis on training operators and engineers;
- Continued commitment to timely repair of steam leaks, damaged insulation, steam traps, etc., and to heat exchanger cleaning;
- Optimization of steam systems;
- Improvements in energy monitoring and control techniques;
- Application of process optimization techniques.

2. Capital Projects:

Some capital investment in energy conservation work occurred in 1989, primarily in the following areas, with close attention paid to achievement of project goals:

- Heat recovery facilities, particularly in crude heat exchangers;
- Improvements in plant automation and control;
- Insulation upgrading;
- Reduction in steam consumption;
- Modifications to raise furnace and boiler efficiencies;
- Facilities to reduce fuel gas production.

Technology Improvements:

Recent gains in energy efficiency have come partly through application of some of the latest advances in technology. The processes used to upgrade and refine crude oil are complex and the improvements easiest to implement were among the first installed. Accordingly, the industry has a strong interest in applied research and development

to attain higher process efficiency. The industry maintains close relationships with scientific and technology research activities worldwide. The types of new technology undergoing rapid development and application include:

- Improved catalysts and additives;
- Facilities to reduce crude oil and product losses;
- New techniques to increase heat recovery;
- Techniques to convert fuel gas components into liquids;
- Advanced computer control and process optimization techniques;
- Sophisticated data management systems;
- Use of high efficiency electric motors;
- Facilities for plantwide monitoring and control of electrical power;
- New types of on-line analyzers;
- Flare gas measurement and recovery.

Task Force Activities

Until now the Petroleum Industry Task Force has been led by two committees: a Steering Committee which sets policy, maintains government relations and establishes funding, chaired by G.G. Myers, and a Technical Committee which reviews industry reporting procedures, receives composite industry data and prepares the annual sector report, chaired by N.J. Little.

To protect the confidentiality of data from individual sources, offices and services of PACE have been used to obtain and consolidate technical data submitted by participating refining companies. It should be noted that all costs involved in the activities of the task force are borne by the petroleum refining industry.

The sector does not consider itself suitable to sponsor or conduct educational workshops. However, member companies are encouraged to participate individually in academic and industrial seminars on energy management and conservation.

Future Outlook

Improvements in operating and maintenance practices and implementation of small capital projects applying recent technological advances will continue to receive the strongest emphasis in the near term, and should yield appreciable improvements in energy use. In Ontario, development of measures to shift electrical loads to accommodate time-of-use electricity rates is continuing.

In the longer term, larger capital expenditures will be required to make further significant progress in energy efficiency in petroleum refining. The investments will proceed if expected rates of return are adequate and capital funds are available. Major advances may be driven largely by the need to reduce emissions of greenhouse gases, particularly carbon dioxide, sulphur dioxide and nitrogen oxides. Reduction in fuel use through energy conservation is gaining support as generally the most cost effective way to curb formation of such gases. The highly competitive nature of the industry and the need to remain competitive will also spur the drive toward higher energy efficiency.

Table I

Petroleum Refining Industry Energy Efficiency Improvement

Current year (1989) total energy inputs		323.0 petajoules
New base year (1985) equivalent energy inputs		318.9 petajoules
Gross Improvement	1985 to 1989	-1.3%
Adjustments — (for increased processing severity, changes in product mix, capacity utilization, etc.)		28.5 petajoules
Adjusted base year equivalent		347.4 petajoules
Net Improvement	1985 to 1989	7.0
Efficiency gain	1972 to 1985	25.6
Total gain	1972 to 1989	32.6%

Table II

Petroleum Refining Industry Energy Used in 1989

<u>Type</u>	<u>Percent</u>
Natural Gas	14.3
Electricity (purchased) (a)	14.2
Liquid Petroleum Products:	
Distillate Oil	—
Residual Oil	7.1
Petroleum Coke	19.6
Other Fuels:	
LP Gas	1.1
Refinery Gas	43.6
Steam (purchased)	0.1
Total	100.0

Energy based on (1) company assigned values, (2) measured thermal values,
or (3) U.S. Bureau of Mines values as follows:

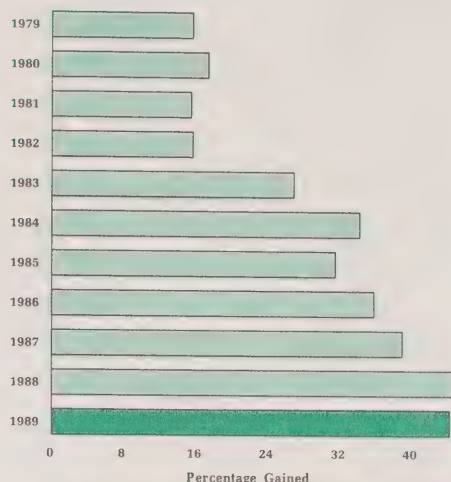
Applied Conversion Factors

Crude Oil	37.660 GJ/m ³
Distillate	38.655 GJ/m ³
Residual	41.721 GJ/m ³
LPG	26.617 GJ/m ³
Natural Gas	38.414 GJ/m ³
Refinery Gas	36.888 GJ/m ³
Petroleum Coke	38.030 GJ/kg
Coal	27.935 GJ/kg
Purchased Steam	2.791 MJ/kg
(a) Purchased Electricity	10,551 MJ/kWh

Plastics Processing Industry

Energy Conservation Task Force

Chris Leclair
Chairman



This report is based on a survey of the processing sector of The Society of the Plastics Industry (SPI) of Canada. Participants consist mainly of independent extruders, injection blow moulding operators and film producers. Resin suppliers, compounders, distribution companies, equipment makers and a large number of processing operations that are an integral part of other reporting industries (e.g., automotive, electrical and electronic, etc.) are not included in performance results.

In 1989, the value of shipments from the processing sector amounted to \$5.6 billion. Based on total estimated fuel and electricity cost of \$95 million for the entire processing sector¹ (including captive operations), this report represents about 28% of the industry's total consumption. The trends described are affected somewhat by minor annual changes in the reporting population and the product mix, but these are not considered detrimental to the

overall integrity of the results.

Energy Efficiency Performance and Trends

Energy efficiency levelled off in 1989 with an aggregated result showing a drop of 0.4% as a result of a 7.9% drop in capacity utilization. Nearly three-quarters of the participating companies reported positive results but these gains were more than offset by a few companies that reported either lower production volumes or changes in their product mix. More extensive industry performance declines have occurred in 1980, 1981, and 1985, as shown in Figure 1, because of capacity shrinkages of 3.3%, 6.4% and 3.7%. The 1989 performance was less affected because of the broader base of markets and growing popularity of dedicating optimum sized production machinery to specific products. Some companies that have installed new equipment have been able to selectively shut down less efficient machines.

There is a trend in this industry to add larger capacity and more

powerful equipment to satisfy the demand for bigger and more complicated products. This trend is causing a noticeable increase in product energy intensities, especially in the electrical consumption share.

In the surveyed group, electricity provides 46% of the energy but accounts for 77% of the total cost. A small number of reporting companies, mainly in Quebec, use only electricity for power and heating. All of the medium to small companies contract for firm service while only a few of the largest find interruptible contracts cost effective. Approximately one-half of companies with firm-service contracts are now affected by Time-Of-Use (TOU) daily and seasonal rates. In these cases, the recent introduction of TOU rates did not make a noticeable difference in the total cost of electricity because the effects were masked by other production and efficiency changes.

Since 1979, use of electricity has grown from 40% to 46% in the surveyed group. This industry-wide

¹Statistics Canada Cat. #31-203 and Cansim data.

shift towards greater use of electricity is due to faster growth in the energy intensive injection-moulding sector and installation of additional larger machinery in existing plants. Many of the new production moulding machines come equipped with high-efficiency motors. While it is often difficult to segregate the mix of operations in some reporting companies, it appears that: (1) film makers get about 73% of their energy from electricity; (2) injection-moulders operate in the 62% range; and (3) blow-moulders and custom fabricators are the least electricity intensive-in the 45% range.

The injection-moulders appear to be the most sensitive to power quality problems. Isolated incidents of power surges and harmonic problems were reported which affect computer controls and/or machine shutdown long enough to freeze the resin in the systems. This can result in serious loss of production and changed operating efficiencies.

Natural gas provides 44% of participants' energy and accounts for 19% of total energy cost. While this energy share has gradually declined from 55% in 1979, the proportions supplied by fuel oil have remained steady at about 5%. Blow-moulding and custom fabricators rely on natural gas mainly for building heat and for generation of some process steam. With so much fuel supplied by clean burning natural gas, these processors need not be too concerned with "green house gas"-emissions.

In terms of cost savings, participants continue to benefit from past efficiency gains. Based on an estimated cost of \$33 million for fuel and electricity, 1989's total would have been \$14 million higher had there been no reduction in overall energy intensities or production efficiency gains. These cost estimates are based on average industry prices of 6.58 cents/kWh, 15.89 cents/m³ for natural gas, and 32 cents for light

fuel oil. Annual energy cost in the surveyed companies varied between \$40,000 and \$2.5 million.

Energy is considered to be a "medium" and "increasingly" important production cost factor resulting in a renewed emphasis on achieving improvements through low-cost means. Though the surveyed companies reported that 6.9% of capital investment went directly to energy retrofits in 1989, efficiency gains were also attributed to the higher cost replacement of some production equipment. As noted below, further gains via improved operating and maintenance techniques will become more important during periods of slowing capital investment.

The energy versus manufacturing cost percentages in the injection-moulding sector still range upwards to about 15% while the amount is somewhat less – around 10% – for the extrusion and blow-moulding sector, and 5% to 8% in the film making business. These percentages vary significantly because of specific products, geographic location and different regional energy prices.

Energy Management Concerns

This year's survey on the relative importance of energy management, sources of future progress and general barriers to greater efficiency revealed a remarkably consistent pattern of concerns from all participants.

Regarding the relative importance of energy management (scored on a scale of 1 - 10), energy received a 5.5, outranked by: immediate concerns for profit improvement (8.9); product quality (8.7); safety and health regulations (8.3); maintenance of facilities and production equipment (7.4); labour productivity and training (7.3); pollution control (6.2); and general cost control and development of new products (6.1).

In light of the energy cost ratios mentioned above and the mandatory nature of most of the other management activities, improving energy efficiency is still a serious concern.

The perceived sources of future improvement differ widely according to the type of processing operation and size of company. For example, while better maintenance (6.9), monitoring and controls (6.5) rated consistently high in all companies, process modifications (aggregated at 6.3) drew a varied response. The collective HVAC potential (6.3), materials handling (5.9), lighting systems (5.5), plant utilities (4.8) and waste heat recovery (4.6) received somewhat less variable but still only moderate concern. Building envelopes and combustion systems are believed to offer the least potential at 4.2 and 3.7. Small companies that rent facilities feel building-related improvements are not their responsibility. In the monitoring and control category, companies known to already have installed state-of-the-art controls still rank this source high. A few of the largest companies are on the verge of installing real-time Data Acquisition Systems (DAS) to prepare for installation of state-of-the-art Computer Integrated Manufacturing (CIM). One of the largest companies was the site of a joint demonstration/monitoring project sponsored by Ontario Hydro and the Ontario Ministry of Energy.

Small companies also recognize the potential of more sophisticated controls and monitoring because they perceive that, even though business is very competitive, there is a great amount of technical knowledge being exchanged within industry.

When it comes to opinions on where to make improvements, the top-rated barriers reflect the primary attention given to the priorities mentioned above. The second great hurdle, showing some consistency at

6.1, was excessively long economic returns. After a variable degree of concern over uncertain business conditions, which often impedes investment decisions, a shortage of technical staff and general technical difficulties scored near the middle range of the scoring system. A

general lack of financial incentives and awareness of opportunities were the lowest-rated impediments to future improvements.

From the low rating (2.9) given to the notion that almost all of the feasible savings have already been

achieved, the survey results indicate that management feels there is much work yet to be done. It would also suggest the total improvement target figure of 50% by 1990 relative to 1980 levels may yet be possible, as well as more significant achievements in years to come.

Table I

Plastics Processing Industry Energy Use

<u>Type</u>	<u>Units</u>	<u>Terajoules</u>	<u>Percentage Distribution</u>		
			<u>1989</u>	<u>1985</u>	<u>1979</u>
Electricity	385,478 MWh	1,387.7	46.1	43.2	40.0
Natural Gas	38,568,177 m ³	1,434.7	47.7	47.2	55.5
Liquid Petroleum Products:					
Distillate Oil	1,630,086 L	63.7	2.1	1.1	1.0
Residual Oil	1,165,200 L	47.2	1.6	3.5	3.0
Diesel & Gasoline	584,837 L	22.9	0.7	0.6	0.2
Other Fuels:					
Others	—	40.5	1.3	—	—
Propane	415,639 L	11.0	0.4	0.2	0.6
Total		3,007.7			

Performance Statistics

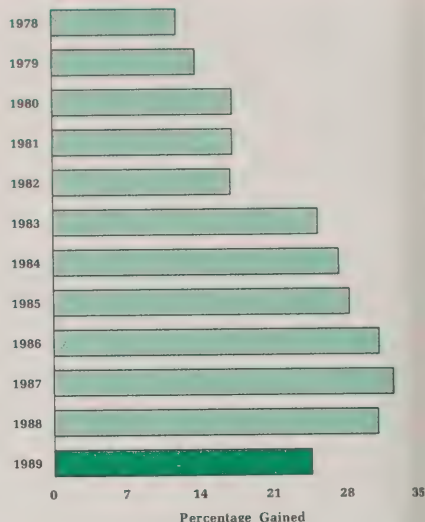
Current year total energy inputs:	3,007.7 Terajoules
Base year (1985) equivalent inputs:	3,162.4 Terajoules

Efficiency Improvement 1979 to 1985 =	31.48%
1986 =	4.35%
1987 =	3.63%
1988 =	5.49%
1989 =	0.41%
Total	44.54%

Pulp and Paper Industry

Energy Conservation Task Force

M.J. Frost
Chairman



Sector Description

The Canadian Pulp and Paper Association's Energy Monitoring Report covers 120 mills accounting for about 95% of the total pulp, paper and paperboard produced in Canada in 1989. Five of the mills included in the report are not members of the Association. A list of participating companies is appended.

Progress Toward Improved Energy Use Efficiency

Purchased energy per tonne of product increased slightly during the year, with the result that the reduction in purchased energy since 1972 now represents 25.8% versus the industry's objective of 33% reduction for the year 1990.

The major energy source continues to be purchased electricity which accounts for 36.7% of the total purchased energy. Heavy fuel oil is 30.1% of the total, which is 45% of the amount used on an equivalent production basis in 1972. Natural gas has increased to 29.5% of the total.

On a unit energy basis, there was a continued reduction in the use of purchased electricity in electric

boilers, which was more than offset by increases in the use of heavy fuel oil and natural gas. Purchased electricity for motive power continued to increase in 1989, reflecting the trend of increasing mechanical pulping capacity.

The reduction in heavy fuel oil use is equivalent to 3.05 billion litres, and in total purchased energy use is equivalent to 2.93 billion litres of heavy fuel oil when compared to the base year of 1972.

Operating Conditions

Shipments of pulp, paper and paperboard for the year 1989 were marginally down from the previous year. The industry as a whole operated at 93% of capacity for the year.

Replacement of fossil fuels by wood wastes generated by the industry and neighbouring wood products operations declined slightly during the past year. These wood wastes now account for 64% of total fuels burned by the industry. Waste fuels plus captive hydraulic power account for 53% of total energy, up from 42% in 1972.

Technological Developments

The Edmundston, New Brunswick mill of Fraser Inc. was awarded CPPA's Technical Section Energy Conservation Opportunity Award in 1989. Stricter control on incoming wood supply and better inventory practices resulted in reduced power consumption at the grinders, a higher production rate, and higher pulp brightness.

There are several benefits from implementing this type of control on incoming wood supply and inventoried stock. First, newer wood with higher moisture content is easier to grind, which results in less power consumption at the grinders and higher production rate at the same time. Second, the new wood provides groundwood pulp with a higher brightness.

Power savings of 16,570 mwh for 1988 are equivalent to \$494,000 based on an average purchased power cost of \$29.81/mwh.

PAPRICAN's research program continues to include many projects with energy conservation aspects. This results in the generation of technological concepts that yield potential reductions in energy consumption and improved overall energy management.

Table I

Pulp and Paper Industry Energy Efficiency Improvement

Current year (1989) total energy inputs	352.31 x 10 ¹⁵ Joules
Base year (1972) equivalent energy inputs	474.86 x 10 ¹⁵ Joules

$$\begin{aligned}\text{Improvement} &= \frac{\text{Base year equivalent} - \text{current year inputs}}{\text{Base year equivalent}} \\ &= \frac{474.86 - 352.31}{474.86} = 25.8\%\end{aligned}$$

Adjustments — None

Survey Data

Number of companies in 1989 report	61
Number of plants in 1989 report	120
Current year consumption	352.31 X 10 ¹⁵ Joules
Current year production	25,649,471 tonnes
Base year consumption	352.50 X 10 ¹⁵ Joules
Base year production	19,040,808 tonnes
Base year volume equivalent consumption	474.86 X 10 ¹⁵ Joules
1990 goal (relative to 1972 base year)	33%

$$\begin{aligned}\text{* Base year (1972) equivalent energy inputs} &= \text{base year consumption} \\ &\times \frac{\text{current year production}}{\text{base year production}}\end{aligned}$$

Table II

Pulp and Paper Industry Purchased Energy Consumption

Energy Source	1972* Joules X 10 ¹⁵	Percentage of Total	1988** Joules X 10 ¹⁵	Percentage of Total	1989** Joules X 10 ¹⁵	Percentage of Total
Coal	16.23	3.4	4.86	1.5	4.11	1.2
Petroleum Products:						
Residual Oil	233.35	49.2	81.92	24.4	105.91	30.1
Distillates	8.74	1.8	4.76	1.4	4.83	1.4
Natural Gas	95.68	20.2	94.02	28.1	103.96	29.5
LPG	1.05	0.2	0.89	0.3	0.81	0.2
Other	4.94	1.0	1.41	0.4	3.27	0.9
Electricity (purchased)	114.87	24.2	147.09***	43.9	129.42****	36.7
Totals	474.86	100.0	334.95	100.0	352.31	100.0

*Reported on 1972 unit use adjusted to 1989 production

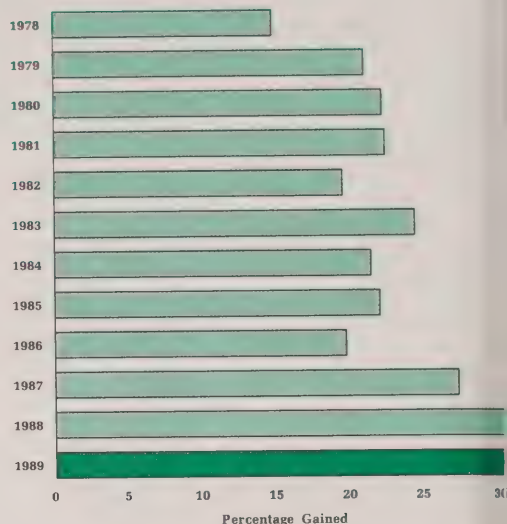
**Actual Use

21.56 X 10¹⁵ Joules (6.4%) used in electric boilers* 3.18 X 10¹⁵ Joules (2.5%) used in electric boilers

Textile Industry

Energy Management Task Force

J. Guy Morin
Chairman



The Energy Management Task Force of the Canadian Textiles Institute represents more than 90% of Canada's textile production.

The textile industry is large and diverse. During 1989 it employed 59,500 Canadians and shipped goods valued at \$6.6 billion, down from \$6.7 billion in 1988.

When the public thinks of textiles, the products which first come to mind are clothes, but this is a far from accurate picture of the industry. While 40% of textile production is shipped to the clothing industry, 60% is sold to over 150 manufacturing industries and to the consumer in the shape of finished goods such as carpets, towels and bed linens. In 1989 the textile industry exported 12.5% of its production.

While textile producers do process and manufacture the natural and synthetic fabrics that clothe us, they also produce the fabrics that furnish our homes and provide the fire hoses that protect them. Ropes, safety harnesses, cords, cordage and twine are all examples of traditional textile products. The industry also produces many space-age products,

among them soft body armour and synthetic arteries.

In the construction industry, textiles help make our roads stronger and our homes and offices more energy efficient. Geotextiles are used to reinforce and strengthen airport runways and major highways. Energy efficient textiles are wrapped around commercial and residential buildings before the brick or siding goes on in order to cut wind penetration and allow trapped moisture to escape.

The textile industry is made up of companies that sell their products to other manufacturing and industrial sectors such as the apparel industry. In the case of products such as carpets, towels and blankets, they are sold directly to the consumer.

1989 Performance

In the textile industry there is a strong correlation between capacity utilization and energy efficiency. Because of the economic slowdown which started in 1989, textile mills did not run at full capacity, and this, combined with a colder than average

December in Quebec, resulted in an energy efficiency loss of 3.3% per kilo of product. When viewed in terms of 1981 constant dollars, the energy efficiency decline almost matches the decline in the value of goods shipped from \$5.553 billion in 1988 to \$5.374 billion in 1989 (a decline in value of 3.2%).

When 1989's declining energy efficiency of 3.3% is deducted from 1988's impressive 5.0% energy improvement, the Textile Task Force stands at an overall energy gain of 28.3%. This is within 7% of the original 1990 target of an energy gain of 29%, and within 2.7% of the new target of a 31% energy efficiency gain now set for 1990.

Task Force Activities

The textile industry has been much concerned with the effects of the Free Trade Agreement and the Canadian International Trade Tribunal's recommendations that textile tariffs be drastically reduced. Also of concern to the textile industry is the current Uruguay Round of the General Agreement on Tariffs and Trade (GATT) negotiations, which is ex-

pected to have significant impact on textile products.

These factors combined with the slowing economy have created a climate of economic uncertainty in the textile industry. This has effectively limited the task force's activities and the industry's interest in energy efficiency.

As well, 1989 has seen an almost complete change of personnel in task force staff. The Energy Management Committee of the Canadian Textiles Institute would like to take his opportunity to thank Luis G. Monton, the former chairman, and Jim Robertson, the former secretary, for their unstinting labour and deep commitment to the cause of energy efficiency. At the same time, the Committee applauds the appointments of Guy Morin as chairman, Guy Leclerc as chairman of the Technical Liaison Subcommittee and Pierre Gagnon as secretary.

Given these developments, the task force spent 1989 in reorganization, deliberating on how best to meet the challenges confronting it.

The economic uncertainty created by the Free Trade Agreement, the Canadian International Trade Tribunal recommendations, and the current round of GATT talks, has left the textiles industry in a position where the investment required to produce outstanding energy efficiency gains is not warranted at present.

To counter this atmosphere, the Energy Task Force has designed a program aimed at restoring the importance of energy management as a vital aspect of profit and loss. Because the efficient use of energy reduces pollution, energy efficiency will be tied to environmental concerns.

The Task Force is planning a series of publications aimed at CEOs that will sidestep energy efficiency as a long-range practical necessity and focus instead on its importance to yearly profits.

The publications will be brief, in light of the limited time CEOs have

to consider extraneous matters. They will also be designed to underline the necessity for plant managers to attend energy management meetings.

To attract more industry participation, the task force has decided to change its meetings into half-day seminars. Where once the emphasis was on the necessity for long-term energy planning, it will now be placed on how to make the most of the present situation.

The seminars will focus on a "nuts and bolts" approach to energy efficiency. Technological innovations and the new generation of energy efficient machinery, as well as recent case histories such as the installation summarized below, will be discussed.

In the past, the Textiles Task Force published two newsletters, *Energy Management Notes*, designed to raise energy efficiency awareness and *Energy Management Techniques*, devoted to case histories and practical energy efficiency concerns. The two publications will now be consolidated into *Textile Energy Management Techniques*. The consolidated publication will feature articles on reducing textile production costs through energy efficiency.

Textile Energy Management Techniques will provide information on new technologies and show what can be done by providing thorough case histories of successful textile industry energy efficient installations. It will also provide the details of energy efficiency programs run by the government and power companies. For the first time, energy efficiency will also be discussed in environmental terms.

Case History

Many textile operations require large amounts of energy to heat water for processes such as dyeing and bleaching. In one bleaching operation the following conversion took place. The technology used, natural gas-fired direct contact hot water heating, is typical of the new

technologies which the Textile Task Force intends to help introduce to the industry in the coming years.

In this case, an eight-year-old steam driven Pick Heater, which ran at 65% efficiency, was replaced by a direct contact gas-fired hot water heater which runs at 99.9% efficiency. The new installation took one week to put in place and contains two burners and two blowers which produce 20 million BTU's an hour and 300 U.S. gallons of hot water per minute. Water temperatures can range from 32° F to 180° F. At the highest water temperatures, the heater will lose some of its efficiency.

By installing the direct-fired gas hotwater heater, manufactured by Sofame Inc., the plant saved the expense of adding a back-up boiler to its operation.

Purchase and installation cost roughly \$100,000. Estimated energy savings for the first year of operation are \$172,000. The payback period is expected to be in the neighbourhood of six months, depending on demand. After four months everything is on stream and plant management plans the installation of another Sofame direct-fired gas water heater to temper water in the boiler room. The hot water heaters are semi-automatic and require intervention only when it is necessary to restart them. Management expects to gain further savings through supervisory personnel reductions in the future.

It is the use of this type of energy efficient machinery, which can be introduced when financial conditions warrant, that the Textile Task Force intends to encourage.

Energy Use Patterns

The consumption of various types of petroleum showed very little change in the textile industry during 1989, remaining almost the same as last year. However, as a percentage of total consumption, the use of natural gas rose to 61.7% in 1989, against 55.0% in 1988. The jump in

natural gas consumption was made at the expense of electricity, which fell to 27.1% of all energy consumed in 1989, against 35.1% in 1988. The drop in the consumption of electricity is within .7% of the jump in natural gas consumption.

This change is explained by the growing cost of electricity in Quebec and Ontario and the economies in energy costs to be gained by using natural gas.

Future Outlook and Concerns

Future energy efficiency gains in the textile industry are problematic. Energy efficiency in the industry is dependent on the state of the economy. If the mills run at capacity, gains will be made. If the economy slows down, losses will occur.

Against this background the textile industry is in a state of flux. While it is a highly competitive and

forward looking industry, it is faced with a period of economic uncertainty brought on by the Free Trade Agreement, the Canadian International Trade Tribunal recommendations and the current round of GATT negotiations. Until the results of these trade agreements are fully analyzed, it is unlikely that the textile industry will invest the amount of capital needed to produce major energy efficiency gains.

Table I

Textile Industry Energy Efficiency Improvement

Current year (1989) total energy inputs	8,439,057 gigajoules
New base year (1985) equivalent energy inputs	8,996,862 gigajoules
Net Improvement	= 3.3%
Adjustments — None	
Efficiency gain 1974 - 1985	22.1
1986	-2.3
1987	6.8
1988	5.0
1989	-3.3
Total gain 1974 - 1987	28.3%

Table II

Textile Industry Energy Use

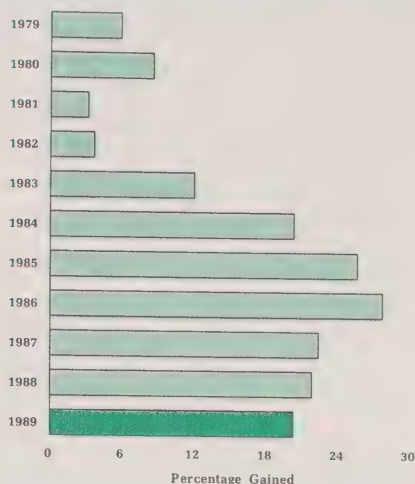
Percentage of Total Consumed

Type	Units	Gigajoules	1985	1989
Natural Gas	139,973,000 m ³	5,207,014	58.4	61.7
Electricity	634,407 MWh	2,283,865	32.3	27.1
Liquid Petroleum Products:				
Residual Oil	20,697 kilolitres	875,504	8.5	10.4
Distillate Oil	353 kilolitres	13,767	0.2	0.2
Diesel & Gasoline	314 kilolitres	11,948	0.2	0.1
Other Fuels:				
Propane & LPG	1,760 kilolitres	46,808	0.5	0.6
Total (1989)		8,439,057		

Transportation Industry (Manufacturing)

Energy Conservation Task Force

Ken Rossi
Chairman



Task Force Profile

The Transportation Industry (Manufacturing) Task Force has membership of 531 companies in the following six trade associations:

- Aerospace Industries Association of Canada (AIAC)
- Allied Boating Association of Canada (ABAC)
- Automotive Parts Manufacturers' Association (APMA)
- Canadian Marine Industries Association (CMIA)
- Canadian Truck and Trailer Manufacturers' Association (CTTMA)
- Motor Vehicle Manufacturers' Association (MVMA)

There are 87 companies reporting energy usage for 1989, an increase of 50% over 1987. While the number has declined slightly from 1988, no doubt due to the declining industry conditions since early 1988, we are nevertheless pleased with the continued and energetic activities of the task force, which has been successful in maintaining this high level of participation.

The 1989 survey trends reflect performance in a very diverse group of large and small companies. Some 6% of consumption was reported

by the large MVMA companies, 23% by the 44 APMA companies, and 9% by 39 diversified members of the AIAC, ABAC, AMIA, and CTTMA associations.

Task Force Activities

The Transportation Task Force continues its mission with monthly meetings and regular technology transfer seminars. Executive meetings usually include representatives of EMR, Ontario Ministry of Energy, and Ontario Hydro, whose organizations help co-sponsor seminars such as "Energy Management for the 90's" held in September.

The highly successful IDEA EXCHANGE newsletter, providing information on energy-related programs, available assistance from government and utilities, case studies from participating companies, etc., is a continuing effort of this task force. This information source also receives wide distribution through trade association media services.

The task force also continues to promote its work through other agencies. For example, the Ontario Ministry of Energy's widely distributed "Source Book" was used to advertise the work of the task force in 1989.

1989 Performance

As shown in the sector performance table, consolidated performance has declined 2.2% during 1989, which drops the group's efficiency 6% below 1985 base year levels. However, consolidated efficiencies are 19.6% better than 1978 operating conditions. While recent trends are disappointing, it must be appreciated that the 1985 reference year was exceptionally good, and subsequent performances are therefore measured against a very high standard. It is also increasingly difficult to aggregate performances in this industry because of frequent changes in products, moderate extent of custom work, and rapid swings in consumer markets.

Nevertheless, individual companies find the performance tracking very useful for identifying the cost impact of changes in productivity.

Sector Performance

ABAC (Boating) and CTTMA (Truck/trailer)

Energy use by companies in these two associations represents less than 1% of the total surveyed by the task force and performance has been difficult to quantify because of widespread industry rationalizations and

the custom nature of production. However, their participation is valuable since it provides a broader perspective on the industry's operating conditions and therefore its performance.

AIAC (Aerospace)

The 27 reporting companies are located mainly in Ontario, Quebec, and Manitoba. Energy usage efficiency is now 3.7% below the 1985 reference point although in the 6-year period prior to 1985, this group had recorded a gain of 20%.

Much of the efficiency loss has resulted from major environmental retrofits required to improve plant safety and health standards. Colder weather in 1989 affected heating requirements, and transfer of some production to parent U.S. plants has also reduced output volumes.

APMA (Auto Parts)

Major efforts to improve productivity throughout this sector have led to an energy end-use efficiency gain of nearly 2% over 1988. Efficiency in the 44 reporting companies is now 6% better than 1985 base year levels.

Companies in this group are upgrading as rapidly as possible to satisfy the stringent production and cost demands of MVMA companies and the fierce competition from offshore and Mexican operations. Production techniques have gone beyond basic Just-In-Time (JIT) concepts. Many companies have now had to adapt plant operations to customers' high standards to ensure there is no weak link in the chain of supply.

CMIA (Shipbuilding)

Energy consumption in the nine reporting companies fluctuates widely from year to year because of unsteady production volumes and uncertain future business. However, energy use per unit of output is now 5.8% below 1985 standards.

MVMA (Motor Vehicles)

MVMA companies' energy efficiency slowed about 1% in 1989, which made the overall performance 9.2% less than peak levels achieved in the 1985 reference year.

Much of the increased energy end-use is attributed to high levels of reconstruction, retooling to accommodate model changeovers, and the added environmental controls of the past few years. More energy is required to control emissions from new painting operations and foundries and to operate extra HVAC comfort equipment.

Lower capacity utilization is also a major factor in the decline of energy efficiency. After a peak of 84.9% in 1985, capacity slid to a low of 65% in the first quarter of 1989 and is forecast to remain low unless there is further rationalization in the industry.

Nevertheless, significant energy conservation improvements have been achieved. For example, in automotive assembly plants where disposal of packaging and shipping materials has always been a major problem, significant portions of steam demand are now generated from these combustible wastes.

A "solar wall" demonstration project at a major automotive plant in Oakville, Ontario, with partial funding from EMR, is now recognized as a major development in storage tank heating. Similar installations are going into service elsewhere in Canada, the United States, and other industrial plants around the world. The developer has recently won an ASHRAE regional award and has been nominated for national recognition.

As well, Ontario Hydro's Energy Management Challenge program has sponsored major lighting retrofits plus installation of many high efficiency motors and variable speed drives.

Energy Use Patterns

Steadily increased use has pushed the natural gas share of total consumption to 60%. The 2% token share of residual oil and 1% for light fuel oil are used mainly for back-up service to satisfy interruptible natural gas contract requirements.

The increasing proportion of electricity, now about 30%, is being monitored carefully because of growing cost and little possibility of substitution.

Coke continues to be a vital source of energy in the MVMA and APMA member companies' foundry operations, with a steady 5% - 7% share over the past ten years.

Future Outlook and Concerns

The principal companies in this task force, members of MVMA and APMA, are confronted with extreme competition in a declining market as well as debilitating overcapacity in the North American industry.

There is also a recognized need to realistically address pressing environmental issues that have now become a major component in corporate planning. Solutions to many of these problems are expensive and it must be acknowledged that in many instances, the technologies utilized in reducing emissions from factories and enhancing the environmental friendliness of the industry products require some sacrifices in energy efficiency.

Therefore, energy managers must continue to be aware of new energy conservation and environmental technology developments as well as the impact of changing energy costs and potential problems in energy supply and distribution infrastructures.

We are confident that significant gains will continue to be accomplished in the improvement of energy efficiency and environmental integrity, and that organizations such as CIPEC have a great role to play in this combined effort.

Table I

Transportation Industry (Mfg.) Energy Efficiency Improvement

Current year (1989) total energy inputs	52,382,420 gigajoules
New base year (1985) equivalent energy inputs	49,412,716 gigajoules
Net Improvement = -6.0%	
Efficiency gain 1978 - 1985	25.6
1986	2.1
1987	-5.4
1988	-4.9
1989	-2.2
Total gain since 1978	25.6
	27.7
	20.2
	20.7
	19.6

Table II

Transportation Industry Energy Use

Type	Units	Gigajoules	Percentage of Total Consumed								
			1989	1988	1987	1986	1985	1984	1983	1982	1981
Natural Gas	851,018,197 m ³	31,657,877	60.4	57.9	58.7	55.7	54.7	54.1	52.1	53.0	49.1
Electricity	4,108,470 MWh	14,790,497	28.2	31.5	32.8	30.7	30.1	29.3	28.4	25.9	23.6
Liquid Petroleum											
Products:											
Distillate Oil	13,164,541 litres	513,417	1.0	1.2	0.8	1.3	1.2	1.2	1.4	1.8	0.7
Crude Oil	n/a	—	—	—	—	0.2	—	—	—	—	—
Residual Oil	29,003,800 litres	1,174,687	2.2	1.7	1.7	1.8	2.1	3.8	8.3	7.5	14.7
Gasoline	647,598 litres	23,454	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.2
Diesel	1,062,025 litres	42,375	0.1	0.1	0.1	0.1	0.2	0.3	0.2	0.4	0.3
Turbine Fuel	3,085,011 litres	111,677	0.2	—	—	—	—	—	—	—	—
Coal	36,586 tonnes	994,773	1.9	1.8	2.2	3.5	3.5	3.5	4.0	3.9	5.9
Coke	94,622 tonnes	2,858,534	5.5	5.4	5.5	6.1	7.4	7.3	7.2	5.8	5.1
Other Fuels:											
Propane	7,959,054 litres	211,483	0.4	0.4	0.2	0.5	0.8	0.3	0.3	0.4	1.4
LPG	135,639 litres	3,676	0.1	0.1	0.1	—	—	—	—	—	—
Total		52,382,420									

Table III

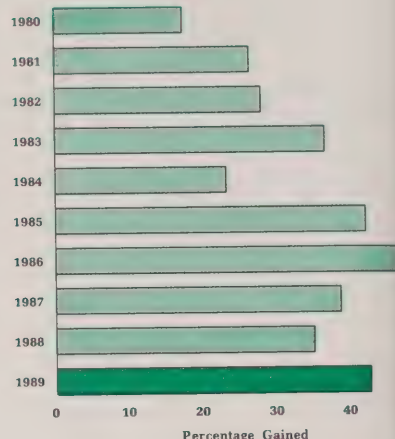
Transportation Industry Energy Efficiency

Subsector	Base Year 1985						Base Year 1978				
	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979
ABAC (Boating)	—	—	—	—	—	2.9	3.1	-48.5	-88.1	—	-0.7
AIAC (Aerospace)	-3.7	2.8	5.2	5.2	20.5	7.9	7.8	3.9	-43.7	6.0	-1.2
APMA (Auto Parts)	6.0	4.9	3.0	2.7	8.5	13.5	11.7	5.8	26.7	15.6	3.3
CMIA (Shipbuilding)	-5.8	1.9	15.2	-19.4	11.4	-3.9	-10.8	-21.2	48.1	-14.1	-9.9
CTTMA (Truck/Trailer)	—	-0.2	9.0	—	-26.3	-15.4	-58.9	-65.2	25.8	-18.1	-0.2
MVMA (Motor Vehicles)	-9.2	-8.6	-8.8	2.0	28.8	22.8	-6.3	3.3	—	—	—
Task Forces	-2.2	-4.9	-5.4	2.1	25.6	20.3	1.2	3.7	8.9	4.5	-0.4

Wood Products Industry (Western)

Energy Conservation Task Force

R.C. (Dick) Bryan
Chairman



Task Force Description

The Wood Products Industry (Western) Task Force was formed by the Council of Forest Industries of British Columbia (COFI) in 1978. It represents 80 companies with more than 100 sawmills and 15 plywood and veneer mills. COFI members and affiliates account for more than 90% of the total product value of the forest industries in British Columbia.

Most mills in western Canada are members of industry trade associations which actively pursue a variety of business issues of common interest. In British Columbia, the major forest industry associations are the Council of Forest Industries of B.C., its Northern Interior Lumber Sector (NILS), the Cariboo Lumber Manufacturers' Association (CLMA) and the Interior Lumber Manufacturers' Association (ILMA). CLMA and ILMA are also affiliate members of COFI.

This survey covers 60 operating sawmills owned by 18 companies

which accounted for 47% of the lumber produced in B.C. in 1989. The coverage in 1989 represents an increase over the 1988 survey which accounted for 43% of B.C. production. The reporting sample covers mills of all sizes and represents all regions in B.C. as well as an Alberta sawmill.

Goals and Progress to Date

The industry's target for 1990 is a 7% overall increase in energy efficiency from 1985 base year performance. The industry's overall average efficiency improvement of 7.3% in 1989 versus 1985 exceeded this target. Although the 1989 performance represented an improvement over 1988, it was one that was based almost entirely on efficiencies in the use of natural gas. The results also show an improvement of 46.9% over the 1978 base year.

Average electrical energy consumption for the production of green lumber showed no significant

improvement over 1988 and none of the lost ground since 1985 was made up. Energy use on a comparable basis was 8.4% more than in 1985. The 1989 performance, when compared with 1978, represented 12.1% improvement.

Compared to 1988, there was significant improvement in the average natural gas consumption in the kiln drying of lumber in 1989. The improvement was 20.8% when compared to the 1985 base year and 63.9% improvement when compared to the 1978 base year.

It is gratifying to see respondent support for the survey continue to grow in recent years and we are now reporting on close to one-half of the total lumber production in the province. The reporting sample for kiln-dried lumber grew in 1988 and the gain has been maintained in 1989.

There is no obvious, single reason why electrical energy use in mill converting logs to green lumber

was below the efficiency performance attained in 1985. Sawmills in British Columbia continued to be faced with higher stumpage charges than prior to 1987 and this may be reflected in higher electrical usage in several ways. First, those mills which are high volume commodity-type lumber producers concentrate on achieving the highest possible volume of output, i.e. lowest unit cost, and may be paying attention to only major cost items – wood and labour. For these sawmills, electricity represents a small cost. Other types of mills which are cutting for value rather than volume will be more concerned that they are maximizing the value from each log and this may mean less concern is paid to the smaller costs such as electrical energy use.

In the interior of the province it is customary to kiln-dry lumber using either natural gas or wood waste energy systems. When natural gas prices were rising through the late 1970s and early 1980s, many mills switched from natural gas to wood waste energy systems. Several years ago, as a result of deregulation of natural gas in the province, natural gas prices fell significantly, making that fuel more attractive. In the last year or so, natural gas prices have stabilized. Consequently, there has not been a strong economic incentive to convert from natural gas

to wood waste systems, although progress has been made both in conversions and in improvements to all types of kiln-drying techniques. Natural gas producers are beginning to exert upward pressure on prices and this should result in more conversions to wood waste energy systems in future.

The improvement noted in the natural gas performance is also due, in part, to the fact that our sample of mills varies from year to year. Variations in our reporting sample mean that relatively small changes in the sample can affect natural gas energy performance.

Energy-Related Activities

COFI continues to provide a secretariat/coordinating role regarding the B.C. wood products industry's energy initiatives. Typically, these activities focus on regulatory matters but include other aspects such as the terms and conditions of energy supply.

Activities in 1989 centred on the proposed natural gas pipeline to Vancouver Island and the possibility of replacing heavy fuel oil, both local and imported, with B.C. natural gas. The other major activity in 1989 was the Westcoast Energy Hearing which

dealt mainly with rate concerns and the issue of capacity on the transmission line.

Energy conservation activities were largely limited to collecting, analysing and reporting on the energy performance data contained in this report.

Future Outlook

Following a slight decline in 1989, lumber production in B.C. is expected to improve marginally in 1990. Exports to the U.S. are expected to be stable and offshore markets should strengthen modestly.

Profitability has been virtually non-existent in the B.C. lumber industry for several years, due in part to the increased stumpage charges mentioned earlier and the increase in the value of the dollar. Economic forecasts of an improvement in 1991 should be reflected in lumber markets. It is not clear how the stumpage situation will resolve itself although most forecasters do expect a drop in the value of the Canadian dollar.

Over the longer term, there is a strong movement in B.C. to reduce the output of commodity-type lumber and to replace that production with higher value-added products.

Wood Products Industry (Western)

Energy Efficiency Improvement

<u>Green Lumber</u>	<u>1989</u>	<u>1985</u>	<u>1978</u>
Total sample production (million board feet — MMFBM)	7221.3	5052.0	4202.2
Total electrical energy consumption (10^{12} J)	3472.3	2241.5	2297.7
Average electrical energy consumption (10^9 J per MFBM)	0.481	0.444	0.547
Current year total electrical energy inputs (10^{12} J)	3472.3	2241.5	2297.7
Comparison base year (1985) equivalent energy inputs (10^{12} J)	3203.9		
Comparison base year (1978) equivalent energy inputs (10^{12} J)	3948.5		

Improvement (1985 base year) = -8.4%

Improvement (1978 base year) = 12.1%

<u>Kiln Dried Lumber</u>	<u>1989</u>	<u>1985</u>	<u>1978</u>
Total sample production (MMFBM)	4816.4	3159.4	1013.0
Total energy consumption (mainly natural gas) 10^{12} J	2936.4	2433.0	1708.8
Average energy consumption (10^9 J per MFBM)	0.610	0.770	1.687
Current year total energy inputs (10^{12} J)	2936.4	2433.0	1708.8
Comparison base year (1985) equivalent energy inputs (10^{12} J)	3709.0		
Comparison base year (1978) equivalent energy inputs (10^{12} J)	8124.6		

Improvement (1985 base year) = 20.8%

Improvement (1978 base year) = 63.9%

<u>Combined Energy Performance</u>	<u>1989</u> <u>Actual</u>	<u>1985</u> <u>Equiv.</u>	<u>1978</u> <u>Equiv.</u>
Total electrical energy consumption (Green Lumber 10^{12} J)	3472.3	3203.9	3948.5
Total natural gas consumption (Kiln Dried 10^{12} J)	2936.4	3709.0	8124.6
Total sector energy consumption 10^{12} J	6408.7	6912.9	12073.1

Improvement (1985 base year) = 7.3%

Improvement (1978 base year) = 46.9%

Reporting Companies

Chemical

Chemkem Inc.
 ASFC Canada Inc.
 L. Blachford Ltd.
 (Arbochem Inc.
 Commercial Alcohols Limited
 Vanamid Canada Inc.
 Bow Chemical Canada Inc.
 InPont Canada Inc.
 Iso Chemicals Canada
 General Chemical Canada Inc.
 F. Goodrich Canada Inc.
 Enkel Canada Inc.
 Echst Canada Inc.
 N & T Chemicals Ltd.
 National Silicates Limited
 Trochem Inc.
 Vavacor Chemicals Ltd.
 Cychem Canada Inc.
 eNord Inc.
 Sell Canada Chemical Company
 Elco Chemicals Limited
 Erpass Chemicals Ltd.
 Oxide Canada Inc.
 Lion Carbide Canada Limited
 Diroyal Chemicals Inc.

Electrical and Electronic

Canada Inc.
 an Wire and Cable Ltd.
 en-Bradley Canada Ltd.
 Andrews Antenna Co. Ltd.
 Ableton Electric Limited
 Fair Canada Limited
 E Electronics Ltd.
 nco Ltd. (Hamilton, Ont.)
 nco Ltd. (Montreal, Que.)
 Canada Wire and Cable Ltd.
 eelec Industrie Inc.
 Commander Electrical
 quipment Inc.
 Commander Electrical Materials Inc.
 an Yale Ltd.
 dards, a unit of General
 gnal Ltd.
 ro Canada Inc.
 eeral Wire & Cable Ltd.
 enum Corporation
 old Shawmut Company Ltd.

GTE Sylvania Ltd.
 Hamilton Porcelains Limited
 Honeywell Limited
 Hoover Canada Inc.
 Hubbell Canada Inc.
 Iona Appliances Inc.
 ITT Cannon Canada
 Klockner Moeller Ltée
 Lincoln Electric Co. of Canada Ltd.
 Lumacell Inc.
 MIL Tracy
 Moloney Electric Corporation
 Motorola Information Systems
 NEI Ferranti Packard Electronics
 Novatel Communications Ltd.
 Ouellet Canada Inc.
 Philips Electronics Ltd.
 Pursley Inc.
 Reliance Electric Limited
 Rockwell International of
 Canada Ltd.
 Smith & Stone (1982) Inc.
 Spar Aerospace Limited
 Square D Canada Ltd.
 Temco Electric Products Co. Inc.
 Thomas & Betts Ltd.
 Thomson Consumer Electronics
 Trench Electric
 WCI Manufacturing Limited
 (Cambridge, Ont.)
 WCI Manufacturing Limited
 (L'Assomption, Que.)
 Woodhead Canada

Ferrous Metals

The Algoma Steel Corporation
 Dofasco Inc.
 Stelco Inc.
 Sydney Steel Corporation (Sysco)

Food and Beverage

Bakeries

Ben's Limited
 Corporate Foods Limited
 Eastern Bakeries Limited
 McGavin Foods Limited
 Multi-Marques Inc.

Biscuit Manufacturers

Christie Brown & Company Ltd.
 Colonial Cookies Ltd.
 Aliments Culinar Inc.
 Interbake Foods Limited
 Manning Biscuits Ltd.
 Windsor Wafers Inc.

Breweries

Labatt Breweries of Canada Limited
 Molson Breweries of Canada
 Limited
 Moosehead Breweries Limited
 Northern Breweries Ltd.
 Pacific Western Brewing Co. Ltd.
 Upper Canada Brewing Co. Ltd.

Confectionery Manufacturers

Adams Brands Inc.
 Donini Chocolate Ltd.
 Ganong Brothers Ltd.
 Hershey Canada (Montreal) Inc.
 Kerr Bros. Limited
 Leaf Confections Ltd.
 Nestlé Enterprises Ltd.
 O-Pee-Chee Company Ltd.
 Rowntree Mackintosh Canada Ltd.
 Trebor Canada Inc.
 William Neilson Ltd.
 Wrigley Canada Inc.

Distilleries

Alberta Distillers Limited
 Canadian Mist Distillers Limited
 FBM Distillery Co. Limited
 Gilbey Canada Inc.
 Gooderham & Worts Limited
 Hiram Walker & Sons Limited
 Joseph E. Seagram & Sons Limited
 Liqueurs Saguenay Ltée
 Palliser Distillers Limited
 Schenley Canada Inc.

Food Processors

Campbell Soup Company Ltd.
 Hunt-Wesson Canada Ltd.
 H.J. Heinz Company of Canada Ltd.
 Kellogg Canada Inc.

Morrison Lamothe Inc.
 Omstead Foods Ltd.
 Produce Processors Limited
 Royal City Foods Ltd.
 Snowcrest Packers Ltd.
 Sun-Brite Canning Ltd.
 Sunland Foods Ltd.
 Sun-Rype Products Ltd.
 Thomas Canning (Maidstone) Ltd.
 Trebor Canada Inc.

Fisheries

British Columbia Packers Limited
 Blue Water Seafoods Limited
 Connors Bros., Limited
 National Sea Products Limited

Grocery Products Manufacturers

Agropur Cooperative Ltée
 Campbell Soup Company Ltd.
 Canadian Home Products Ltd.
 Catelli Inc.
 Culinar Inc.
 General Foods Ltd.
 Jacobs Suchard Canada Inc.
 Kellogg Canada Inc.
 Kraft Ltd.
 Lancia Bravo Foods Limited
 McCormick Canada Inc.
 Monarch Fine Foods Ltd.
 Nabisco Brands Ltd.
 Nacan Products Ltd.
 Warner-Lambert Canada Inc.

Meat Processors

Burns Meats Inc.
 Canada Packers Inc.
 F.W. Fearman Company Ltd.
 Intercontinental Packers Ltd.
 J.M. Schneider Inc.
 Piller Sausages & Delicatessens Ltd.
 Quality Meat Packers Ltd.
 Unox, Division of
 Thomas J. Lipton Inc.
 Vancouver Fancy Meats Co. Ltd.

Poultry and Egg Processors

A.C.A. Co-operative
 Association Ltd.
 Bexel, Division of Co-op.
 Fédérée de Quebec
 Canada Packers Inc.
 Co-op Dorchester Ltée
 Coulombe Quebec Ltée
 Export Packers Company Ltd.
 La Poulette Grise

Lashbrook Produce Limited
 Lilydale Co-op Limited
 Lilydale Poultry Sales (Victoria) Ltd.
 Lucerne Foods Ltd.
 Maple Leaf Mills Limited
 Maple Lynn Foods Ltd.
 Pembina Poultry Packers Ltd.
 P & H Foods Ltd.

Sugar Refineries

Atlantic Sugar Limited
 British Columbia Sugar Refining
 Company Limited
 Lantic Sugar Limited
 Redpath Sugars Limited

Wineries

Andre's Wines Ltd.
 Inniskillin Wines Inc.
 Les Vins La Salle Inc.

General Manufacturing

Chemical, Pharmaceutical and Medical Products

Atkemix Inc.
 Glaxo Canada Inc.
 Estée Lauder Cosmetics Limited
 Ferro Industrial Products Ltd.
 Canadian Occidental Petroleum
 Limited
 Diversey Wyandotte Inc.
 Tambrans Canada Inc.

Foundries, Forgings and Heavy Metal Processors

Bibby-Ste-Croix Foundries Ltd.
 Canada Forgings Inc.
 Canadian Blower/Canada
 Pumps Ltd.
 Canadian Bronze Company Limited
 Canada Ingot Mould Inc.
 Canvil Ltd.
 Esco Ltd.
 Fahramet, Indusmin, Div. of
 Falconbridge
 Hawker Siddley Canada Inc.
 Huron Steel Products Limited
 Lake Ontario Steel Company
 Limited
 Manville Canada Inc.
 Metals & Alloys Company Limited
 Reynolds Aluminum Company
 Limited
 Slater Steels, Sorel Forging Division
 The Canada Metal Company Limited

Light Manufacturing

Abex Industries Ltd.
 Atco Limited
 Butler Metal Products Limited
 Black and Decker Canada Inc.
 Bombardier Inc.
 Cooper Tools Ltd.
 Dominion Controls Co. Ltd.
 Fasco Products, Div. of Indal
 Indal Technologies Inc.
 Indalloy Ltd., Div. of Indal
 Kawneer Company of Canada
 Limited
 Kodak Canada Inc.
 Paddle Valley Products Limited
 Snap-On Tools Ltd.
 Teledyne Canada Metal Products
 Limited
 Trane Canada Limited

Rubber Products

Gates Canada Limited
 General Tire Ltd.
 Michelin Tires (Canada) Ltd.
 Trent Rubber Services Limited
 Uniroyal-Goodrich Canada Ltd.

Industrial Minerals

Abrasives

Exolon - Esk Co. of Canada Ltd.
 General Abrasives - Abrasives
 Industries (Canada) Inc.
 Norton Advanced Ceramics
 of Canada Inc.
 Washington Mills Electro
 Minerals Corp.

Asbestos

Brinko Mining Ltd., Cassiar Division
 JM Asbestos Inc.
 Lab Chrysotile (Bell) Inc.
 Lab Chrysotile (Lac)
 Lab Chrysotile (BC/KB/
 Normandie) Inc.

Cement

Inland Cement Limited
 Lafarge Canada Inc.
 Lake Ontario Cement Limited
 (ESSROC Canada Inc.)
 North Star Cement Limited
 St. Lawrence Cement Inc.
 St. Mary's Cement Corporation
 Tilbury Cement Limited

Clay Brick and Tile

riquerie St. Laurent Ltée
stevan Brick Company Limited
lamilton Brick Ltd.
ISP Investments Limited
(Div of NSP Inc.)

Concrete Products

oughty Concrete Products Ltd.
owney Building Materials Ltd.
enstar Materials Limited
ichvale Block & Ready-Mix (Div. of
Canada Cement Lafarge Ltd.)
upercrete (Div. of Canada Cement
Lafarge Ltd.)
ork Block (Div. of Canada Cement
Lafarge Ltd.)

Glass

FG Glass Inc.
Consumers Packaging Inc.
Ibreglass Canada Inc.
Ibbey St. Clair
PG Canada Inc.

Lime

Ivelock Lime Company of
Canada Limited
Izenac Inc.
Fiss Lime Company of Canada
Limited
Elco Steel Company Limited
Emmit Lime Works Limited

Miscellaneous Minerals

Falconbridge Ltd.
Fusmin Limited
31 Canada Inc.
Saskatchewan Minerals Ltd.
Setley Talc Inc.

Refractories

Canadian Refractories Limited
Cyburn Refractories Limited
Continental Refractories Company
Limited
General Refractories Co. of
Canada Ltd.

Machinery

ACO Canadian Material Handling
Division of Babcock Industries
Canada Inc.
S. Armstrong Limited
Alliers FABRON Inc.
Beco Conveying Systems

Black Clawson-Kennedy Limited
Boart Canada Inc.
Canadian Blower/Canada Pumps
Limited
Continental Conveyor & Machine
Works Ltd.
Continuous Mining Systems Limited
Dresser Pump Division,
Dresser Canada Inc.
FAG Bearings Ltd.
General Conveyor Co. Ltd.
Gorman-Rupp of Canada Limited
Greedy Lightnin
Heath & Sherwood (1964) Limited
Industries USP Inc.
Ingersoll-Rand Canada Inc.
ITT Fluid Products Canada
Jenkins Canada Inc.
H.J. Langen & Sons Limited
MTD Products Ltd.
RMS Machinery Division,
Uniroyal Goodrich Canada Inc.
Smart Turner Limited
Ward Ironworks Limited
Webster Air Equipment
Division of Curtiss-Wright of
Canada Inc.

Mining and Metallurgy

Central Canadian Potash Co. Ltd.
Cominco Ltd.
Denison Mines Inc.
Echo Bay Mines Inc.
Falconbridge Ltd.
Fording Coal Ltd.
Giant Yellowknife Ltd.
Hudson Bay Mining and
Smelting Inc.
INCO Ltd.
Iron Ore Company Ltd.
Noranda Ltd.
Placer Dome Inc.
Quebec Cartier Inc.
Rio Algom Ltd.
Suncrude Ltd.
Tech Corporation Ltd.

Petroleum Refining

Consumers' Co-Operative
Refineries Limited
Esso Petroleum Canada
Husky Oil Products Company

Petro-Canada Products Inc.
Shell Canada Limited
Suncor Inc.
Syncrude
Texaco Canada Inc.
Turbo Resources Limited
Ultramar Canada Inc.

Plastics

Acriform Engineering Ltd.
American Biltrite (Canada) Ltd.
Atlantic Packaging Products Ltd.
Automotive Industries Ltd. (Donlee)
Beaver Plastics Limited
Bonar Plastics Ltd.
Burman-Castrol Canada Ltd.
Canadian General Tower Ltd.
Celfortec Inc.
Chemacryl Plastics Limited
Coastal Plastics Ltd.
Daymond, Div. of Redpath
Industries Ltd.
Duron Plastics Ltd.
F&H Plastics Ltd.
Ferro Industrial Products Ltd.
Formica Canada Inc.
Hayden Manufacturing Co. Ltd.
Horizon Plastics Ltd.
Jet Moulding Compounds Ltd.
Les Plastiques Anchor Ltée.
Les Systemes Thermoplast Inc.
Medallion Plastics Ltd.
Morbern Inc.
Pavaco Plastics Inc.
PCL Packaging Inc.
Plasti-Drain Ltée.
Plasti-Fab Ltd.
Plax Inc.
Polytainers Inc.
Pro-Western Plastics Ltd.
Relmech Manufacturing Ltd.
Rubbermaid Canada Inc.
Roll-O-Sheets Canada Limited
Scepter Manufacturing Co. Ltd.
Scott Polymers Ltd.
Shaw Industries Ltd.
Schlegel Canada Inc.
Tupperware Company Inc.
Union Carbide Performance
Plastics Ltd.
Uniplast Industries Ltd.
Vanguard Plastics Ltd.

Pulp and Paper

Abitibi-Price Inc.
Armstrong World Industries Inc.
Atlantic Packaging Products Ltd.
Beaver Wood Fibre Co. Ltd.
Boise Cascade Canada Ltd.
Bowater Mersey Paper Company Limited
Canadian Forest Products Ltd.
Canadian Pacific Forest Products Limited
Cariboo Pulp & Paper Company
Papier Cascades (Cabano) Inc.
Cascades (East Angus) Inc.
Cascades (Jonquière) Inc.
Calgar Pulp Company
Corner Brook Pulp & Paper Ltd.
Crestbrook Forest Industries Ltd.
Daishowa Inc.
Domtar Inc.
Donohue Inc.
Donohue Normick Inc.
Donohue St. Félicien Inc.
E.B. Eddy Forest Products Ltd.
Eurocan Pulp & Paper Co. Ltd.
Fletcher Challenge Canada Limited
J. Ford & Company Ltd.
Fraser Inc.
Gaspesia Pulp and Paper Company Ltd.
Howe Sound Pulp and Paper Limited
Irving Pulp & Paper, Limited
Island Paper Mills Company
James River - Marathon, Ltd.
Kruger Inc.
James MacLaren Industries Inc.
MacMillan Bloedel Limited
Malette Kraft Pulp & Power Inc.
Minas Basin Pulp and Power Company Limited
Miramichi Pulp and Paper Inc.
NBIP Forest Products Inc.
Noranda Forest Recycled Papers
Northwood Pulp and Timber Limited
Paperboard Industries Corporation
Perkins Papers Ltd.
Procter & Gamble Inc.
Quebec and Ontario Paper Company Ltd.
Repap Manitoba Inc.
Rolland Inc.
Rothesay Paper Limited

St. Anne-Nackawic Pulp & Paper Company Ltd.
St. Marys Paper Inc.
Scott Maritimes Limited
Scott Paper Limited
Skeena Cellulose Inc.
F.F. Soucy, Inc.
Sonoco Limited
Spruce Falls Power & Paper Company, Limited
Stone-Consolidated Inc.
Stora Forest Industries Limited
Strathcona Paper Company
Tembec Inc.
Weldwood of Canada Limited
Western Pulp Limited Partnership
Weyerhaeuser Canada Ltd.

Canadian Textile Institute

Albany International Canada Inc.
Barrday Inc.
Barrymore Carpet Company
Bell Tootal Inc.
Bermatex Inc.
Britex Limited
Canada Cordage Inc.
Celanese Canada Inc.
Cley & Tinker Inc.
Consoltex Inc.
Coronet Inc., Tapis
Crossley Carpet Mills Ltd.
DeBall Canada Inc., J.L.
Dominion Textile Inc.
Doubletex Inc.
Drytex, Div. of JWI Ltd.
Dura Undercushion Ltd.
Les Tissus Hafner du Canada Ltée
Harding Carpets
Harvey Woods Limited
Huyck Canada Limited
Interface Flooring Systems Canada
La Gran Canada Inc.
Marimac Inc.
Newlands Inc.
Niagara Lockport Quebec Industries Inc.
Nova Scotia Textiles Ltd.
Ozite Canada (1081) Inc.
Patons & Baldwins Canada Inc.
Peeters Carpets Ltd.
Rayonese Textile Inc.
Rubyco (1987) Inc.
Rumpel Felt Co. Ltd.
Sauquoit Industries Ltd.

Scotwell International Inc.
Spinrite Yarns & Dyers Ltd.
Stewart Group Ltd.
Les Tapis Peerless Ltée. (Plant No.)
Tapis Venture Ltée.
Textiles Dionne Inc.
Tricots Canada U.S. Inc.
Tricots Duval & Raymond Knitting Ltée, Les
Union Felt Products Ont. Ltd.
Vagden Mills Ltd.
West Coast Woollen Mills (1986) Ltd.

Transportation (Mfg.)

Aerospace Industries Association of Canada

Aircraft Appliances and Equipment Limited
Airtech Canada
Allied Signal Aerospace Canada, Bendix Avelex Inc.
Allied Signal Aerospace Canada, Garrett Canada
BOEING CANADA, de Havilland Division
Bombardier Inc., Canadair Division
CAE Electronique Ltée.
Canadian Marconi Company
Chicopee Manufacturing Limited
Computing Devices Company
Ebco Industries Ltd.
Field Aviation East Ltd.
H.I. Thompson Co.
Haley Industries Ltd.
Indal Technologies Inc.
Litton Systems Canada Limited
Lucas Aerospace Inc., Control Systems Division
McDonnell Douglas Canada Ltd.
Oerlikon Aerospace
Raytheon Canada Limited
Rockwell International of Canada Ltd.
Rolls-Royce (Canada) Limitée
Spar Aerospace Limited
Tube-Fab Ltd.
UDT Industries Inc.
Unisys Canada Inc.
Walbar Canada Inc.

Automotive Parts Manufacturers Association

A.W.K. Industrial Coating

Accurcast Limited
 Algoods, Division of Alcan
 Aluminum Limited
 Alcan Castings Limited
 & W Heat Treating (1975) Limited
 Berger Precision Ltd.
 Blackstone Industrial Products
 Limited
 Budd Canada Inc.
 Cutler Metal Products, A Division of
 BMG Canada Limited
 Canada Forgings Inc.
 Chichane Tool & Design Limited
 Collins & Aikman, A Division of
 WCA Canada Inc.
 Gussa Canada Ltd.
 Dominion Controls Company
 Eaton Industries Inc.
 G Bearings Ltd.
 Phramet Steel Castings
 E Plastics Canada Ltd.
 Goodyear Canada Inc.
 Hayes-Dana Inc.
 Hyundai Auto Canada Inc.
 M/Krebsoge
 e Moulding Compounds Limited
 nson Controls Inc.
 K.sey-Hayes Canada Limited
 gran Canada Inc.
 /D Products Limited
 hirin Inc.
 B Canada Inc., Duplate Division
 Quality Safety Systems Company
 enolds Aluminum Company of
 Canada Ltd.
 Blackwell International Suspension
 systems Company
 Hller-Globe
 inens-Bendix Automotive
 lectronics Limited
 iperis Inc.
 der Steels Corporation
 tandard Tube Canada Inc.
 tenco Canada
 ena International Inc.
 hmson (Canada) Rivet Co. Limited
 hssen Marathon Canada
 ington, Div. Ingersoll-Rand
 Canada Inc.
 R/ Canada
 ethead Industries

Canadian Marine Industries Association

International Paints (Canada)
 Limited
 Marystown Shipyard Ltd.
 MIL Davie Inc.
 MIL Tracy, MIL Group
 Port Arthur Shipbuilding
 St. John Shipbuilding Limited
 Securiplex
 Vancouver Shipyards
 Versatile Pacific Shipyards Inc.

Canadian Truck and Trailer Manufacturers' Association

Fruehauf Canada, A Division of
 Gemala Industries Ltd.

Allied Boating Association of Canada

ITT Fluid Products Canada

Motor Vehicle Manufacturers' Association

Chrysler Canada Ltd.
 Ford Motor Company of Canada
 Limited
 General Motors of Canada Limited
 Navistar International Corporation
 Canada
 Volvo Canada Ltd.

Wood Products (Western)

Atco Lumber Ltd.
 Canadian Forest Products Ltd.
 Canadian Pacific Forest Products
 Crestbrook Forest Industries Ltd.
 Doman Forest Products Limited
 Evans Products Co. Ltd.
 Federated Co-Operatives Ltd.
 Fletcher Challenge Canada Limited
 MacMillan Bloedel Ltd.
 Nechako Lumber Co. Ltd.
 Northwood Pulp & Timber Ltd.
 The Pas Lumber Company Ltd.
 Quesnel Forest Products
 Riverside Forest Products Ltd.
 Rustad Bros. & Co. Ltd.
 Weldwood of Canada Limited
 West Fraser Mills Ltd.
 Zeidler Forest Industries Ltd.

Appendix A

Reporting Methodology

The objective of the CIPEC monitoring system is to track as closely as possible the actual changes in production energy intensity. Performance monitoring procedures and accounting methodology used by the task forces followed a prescribed aggregating method established by CIPEC in 1975.

The basis of the CIPEC method is to compare energy consumption to physical units of production, where possible. This is done by determining the difference in current year consumption to the energy that would have been used in a base year (at the same level of production) before any efficiency improvements had taken effect.

The quantity of energy savings claimed is calculated as the difference between the total current year energy consumption and the base year equivalent energy consumption. Each year the base year equivalent energy consumption is determined by aggregating the results of each participating company. This method of determining changes in energy-intensities thus incorporates the total effects of changes in production-mix, production volumes, technologies, and energy conservation activities.

Similarly, energy cost savings is the difference between what would have been spent on energy (if there had been no efficiency improvement) and the current energy expense. The figure fluctuates because of the voluntary nature of participation in the program; estimates of energy savings depend on the quantity of energy reported by the CIPEC participating companies and total efficiency improvement in that particular year.

Feedstocks used in the chemical and petroleum refining industries are not included in the task force or CIPEC accounting system since conservation of these commodities is not an issue. However, process improvements which register as site throughput reductions are regarded as conservation of energy. In the ferrous metal industry, the metallurgical coal that is used to make coke for steel manufacture is treated as a primary fuel input.

Since reporting began, it has been necessary to apply minor adjustments to the consumption numbers to normalize the impact of fluctuations in weather, added energy consumption from imposed environmental equipment and period changes in raw material quality. These corrections are done at the individual company level which often report both gross and net efficiencies. This practice will be continued to allow participants to make future adjustments where necessary.

After more than a decade of CIPEC monitoring most task forces update individual reference years to 1980 to recognize the many fundamental changes that have occurred since the beginning of the program. Reporting of future performances will carry forth the past achievements, however, to retain the long term trend in performance.

Appendix B

Prefix	Multiple	Symbol
kilo	10^3	k
mega	10^6	M
giga	10^9	G
tera	10^{12}	T
peta	10^{15}	P
exa	10^{18}	E

Energy	Metric	Imperial
Electricity – net	3.6 MJ/kWh	3,414 BTU/kWh
– gross	10.551 MJ/kWh	10,000 BTU/kWh
Natural Gas	37.2 MJ/m ³	1.0×10^6 BTU/MCF
Propane	26.6 MJ/litre	0.1145×10^6 BTU/G
Crude Oil (#6)	38.5 MJ/litre	5.8×10^6 BTU/bbl
Distillate Oil (#2)	39.0 MJ/litre	0.168×10^6 BTU/G
Residual Oil (#5)	42.3 MJ/litre	0.182×10^6 BTU/G
Coal – Bituminous	32.1 GJ/tonne	27.6×10^6 BTU/ton
– Subbituminous	22.1 GJ/tonne	19.0×10^6 BTU/ton
– Metallurgical	29.0 GJ/tonne	25.0×10^6 BTU/ton
Coke – Petroleum (Raw)	23.3 GJ/tonne	20.0×10^6 BTU/ton
Gasoline	36.2 MJ/litre	0.156×10^6 BTU/G
Diesel Fuel	39.9 MJ/litre	0.172×10^6 BTU/G
Kerosene	38.8 MJ/litre	0.167×10^6 BTU/G
Liquid Propane Gas (LPG)	27.1 MJ/litre	0.117×10^6 BTU/G

To Convert from	to	Multiply by
Cubic Feet	Cubic Metres	0.028
Cubic Feet	Gallons (Imperial)	6.229
Cubic Feet	Litres	28.316
Barrel (Oil)	Cubic Metres	0.159
Barrel (Oil)	Gallons (Imperial)	34.973
Gallon (Imperial)	Litres	4.546
Gallon (U.S.)	Gallons (Imperial)	0.8327
Short ton	Pounds	2000
Short ton	Tonnes	0.9072
Tonne	Short tons	1.102
Long ton	Pounds	2240
Long ton	Tonnes	1.016
Kilogram	Pounds	2.205
BTU	Joules	1055.1
Kilojoule	BTU	0.948
Gigajoule	Barrels Oil Equiv.	0.164

The information, perspectives and data reported herein are solely the responsibility of the Canadian Industry Program for Energy Conservation Council and the reporting task forces.

The co-operation and support of Energy, Mines and Natural Resources Canada in the preparation of this report is appreciated.



Energy, Mines and
Natural Resources Canada

Energie, Mines et
Ressources Canada

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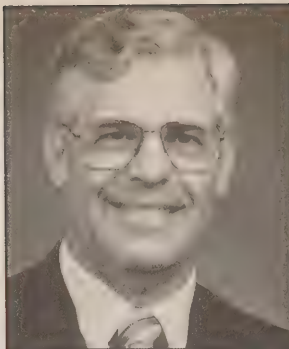
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Publications

Canadian Industry Program for Energy Conservation



1990

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CANADIAN
INDUSTRY PROGRAM
FOR ENERGY CONSERVATION

PROGRAMME CANADIEN
D'ÉCONOMIE D'ÉNERGIE
INDUSTRIELLE

October 30, 1991

The Honourable Jake Epp, P.C., M.P.
Minister of Energy, Mines and Resources
House of Commons
Ottawa, Ontario
K1A 0A6

Dear Minister,

The 1990 energy performance of CIPEC reporting companies was significantly affected by low production volumes and capacity utilization. As a result, energy use per unit-of-output deteriorated by 2.7% in 1990 as compared to 1989. It is also the principal reason why CIPEC has fallen short of the 1990 target of 31% improvement over the 1973 reference base year.

Despite this disappointing performance, energy utilization in 1990 has improved by 26.2% since the 1973 reference year.

Canada and Canadian industry are energy intensive, and the reasons for this are very complex. Our energy use is now being considered, along with that of every other major energy user, in the context of the global warming issue. The CIPEC program, with its unique capabilities and performance monitoring procedure, provides a significant benefit in assessing this energy use. It will also help to deliver Canada's required contribution to evolving environmental objectives.

The "energy environment" is very different from what it was when the CIPEC program began 16 years ago. The need for conservation has been intensified, not only by the global warming problem, but also by the concerns for industries' productivity and competitiveness in world markets. It is now even more important that industry and government maintain and develop the cooperative CIPEC relationship.

We look forward to renewed success.

Sincerely,



W. Peter Torbet
Chairman
CIPEC Council



The Canadian Industry Program for Energy Conservation (CIPEC) is an industry-administered/government-sponsored program for promoting and monitoring energy efficiency throughout the Canadian manufacturing and mining industries.

CIPEC was established on May 23, 1975, as a result of deliberations between the Federal Government Ministers of Energy, Mines and Resources and Trade and Commerce, and 50 of industry's most senior representatives. It now consists of 14 different industrial task forces that represent a broad spectrum of Canadian manufacturing and mining industries.

The program's objectives in promoting energy conservation are to:

- Promote energy productivity improvement in Canadian industry;
- Maintain an effective forum for industry/government dialogue on energy utilization and productivity matters;
- Forecast aggregate energy productivity improvement based on Canadian industry programs;
- Collect data and report on energy productivity of Canadian industry.

Table of Contents

Direction of Energy Conservation

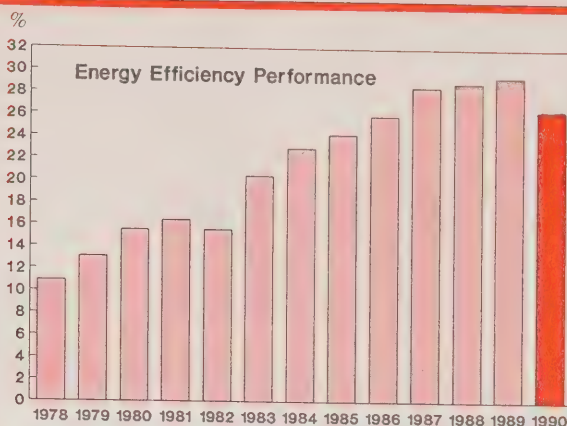
1990 Performance	1
Energy Consumption and Trends	3
Electricity	4
Natural Gas	5
Petroleum Products	6
Coal and Coke	6
Other Fuels	6
Energy and the Environment	7
Greenhouse Gas Emissions	8

Task Force Reports

Chemical	9
Electrical and Electronic	12
Ferrous Metals	15
Food and Beverage	17
General Manufacturing	22
Industrial Minerals	25
Mining and Metallurgy	29
Petroleum Refining	33
Plastics Processing	36
Pulp and Paper	39
Textiles	42
Transportation (Manufacturing)	45
Wood Products (Western)	49

Reporting Companies	51
Appendix A – Conversion Factors	56
Appendix B – Emission Factors	57

CIPEC Consolidated Performance 1990



Industrial energy use efficiency declined 2.7% during the year but is still 26.1% better than it was in the 1973 reference year. The 1990 performance thus fell short of the 31% target figure that was set five years ago. The performance of each participating sector is shown in Figure 2.

Energy use efficiency in this annual report is defined as the rate of change in energy utilization over a specified period of time. Energy consumption per unit of production (energy intensity) is the basic trend that is monitored. This production-based method readily provides the kind of technical information that is used by participants to compare energy intensities and performance trends.

The results in this survey come from 565 of the largest manufacturing and mining companies in Canada representing approximately 70% of the energy used by all of industry. Thirteen of the most energy-intensive industry sectors are included in this annual survey.

The widespread 1989-90 general economic recession was the main reason for this year's decline in industrial energy utilization. While the general economy's GDP at factor cost fell 1.7% below December 1989's, the goods-producing industries, which felt most of the impact, fell 10% below the May 1989 peak. In the manufacturing sector, transportation equipment, wood and plastics industries were the most affected. Economic losses in the mining group were concentrated mostly in the coal, potash and nickel mining sectors which are monitored by CIPEC.

As a result of depressed business and lower production volumes, plant and factory capacity utilization in the total manufacturing sector

decreased from 80% to 74% during the year. This Statistics Canada measurement, however, does not account for the numerous plants that were shut down because of obsolescence or relocated to the U.S. or Mexico. The durable-goods sector ended the year with only 71.1% of its production capability being utilized.

The non-durables sector was somewhat less affected with a decline from 83.7% to 77.1%. In the mining industry, several gold producing companies reported operating at only half of their capacity levels.

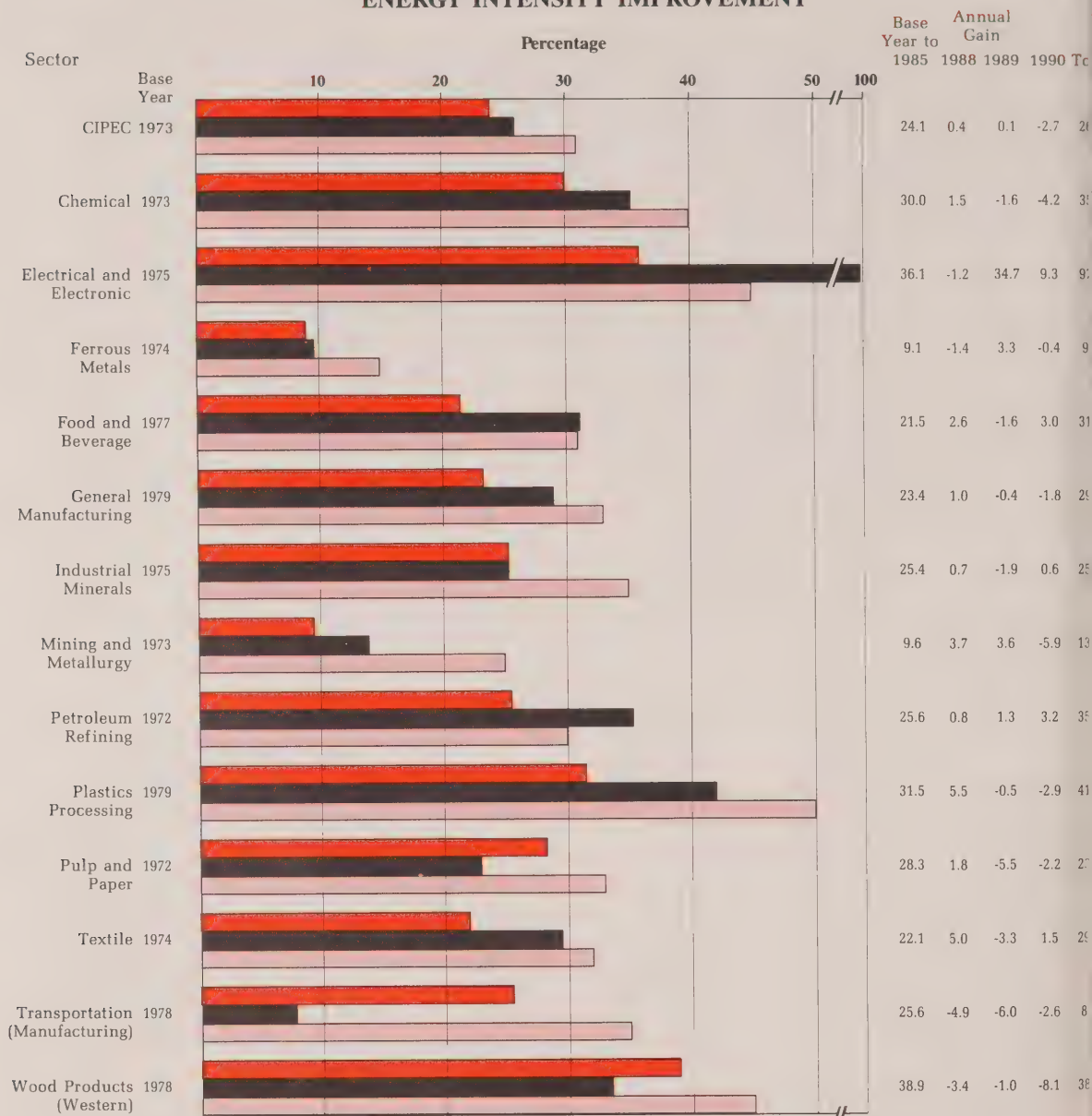
During the past decade, significant changes in industry's operating environment have had a substantial impact on energy utilization. The most universal of these are: the impact of two economic recessions; the profound effects of the Canada-U.S. Free Trade Agreement; widespread restructuring and downsizing strategies designed to meet intensified competition; reduced technical capabilities caused by leaner staffing; deregulation of natural gas contracts that lowered fuel prices and reduced energy conservation momentum; and high interest rates which slowed investment in new projects and retrofits. Individual sectors and their member companies could contribute many other factors to this list.

What's more, these changes have accelerated in the past 5 years to widen the gap between the real and anticipated operating scenario.

The average rate of improvement since the 1973 base year is 1.5% per year. Performance was good prior to the 1982 recession when programs were stimulated by the potential of energy shortages and rapidly escalating prices. During the 1982 recession, energy efficiency fell about 1% when companies

Figure 1

ENERGY INTENSITY IMPROVEMENT



Legend: ■ - 1985 Total Improvement
■ - 1990 Total Improvement
■ - 1990 Goal

Source: CIPEC Task Force Reports

trimmed production to reduce inventory levels and reorganized to launch the necessary new productivity efforts. The recovery years between 1983 and 1987 saw energy efficiency increasing by 2% per year. The flat performance during 1988 and 1989 was a preview of the 1990 decline.

Closer assessment of the linkage between energy efficiency and the key factors of production volumes and capacity utilization reveals that about two-thirds of the gain is due to changes in production volumes. In this sense, the results, although real, can be thought of as being somewhat "soft". In addition, changes in capacity utilization have a similar affect on efficiency. Since capacity utilization has slipped from 86% in 1973 to 79.6% in 1990, it has had a negative impact on energy efficiency throughout most of the CIPEC monitoring period. As a result, only one-third of the net improvements have come from tangible energy conservation actions such as retrofits, process enhancements, better housekeeping and maintenance, redesign of products, etc.

Some fluctuations in energy utilization will inevitably result from variations in production and capacity levels. However, a major effort is necessary to strengthen the consistency and source of sustainable energy utilization to insure that maximum cost savings and control of environmental emissions are achieved.

Many progressive companies have already recognized this need as a result of their "strategic site assessments" and combined energy-environmental audits. In these cases, steps are being taken to redesign processes to be more flexible, while at the same time operating at peak efficiencies. The traditional design philosophy of using single oversized pieces of equipment is giving way to down-sizing and compartmentalizing techniques. Installation of variable speed drives, demand controllers, etc., is now considered essential in new designs.

Routine energy management, according to the surveys, is also showing signs of renewal. For example, some companies are reactivating energy conservation committees. Energy accounting and performance monitoring systems are being computerized to a greater extent. Companies are again expressing the need for up-to-date information and proven energy conservation techniques.

1990's negative efficiency trend is therefore thought to be a low point in the history of the CIPEC program.

Surveyed Energy Consumption

The 1,430 petajoules (PJ) of energy surveyed by CIPEC represents 70% of the total 2,044 PJ used in the industrial sector in 1990.

One PJ of energy is equivalent to 277 million (net) kWh, 26.8 million m³ of natural gas, or 25,641 m³ of distilled fuel oil.

Industry used 32% of the total domestic energy demand in 1990; down from the 37.6% peak level in 1988 and traditional usage of 35% in the middle 1980s. The reduced 1990 consumption share is equal to the percentage of total domestic demand reported during the 1982 recession. Notwithstanding some recovery following the current recession, it is expected industry's proportion will not rise much because of the fundamental structural economic changes now taking place. Industry is down-sizing relative to other sectors of the economy.

This annual CIPEC efficiency survey does not include all sectors defined by Statistics Canada as manufacturing and mining. For instance, construction, oil drilling, secondary textile and clothing, furniture, and other small miscellaneous industries are not surveyed because of their low energy intensities and

Table I

Consolidated Energy Consumption

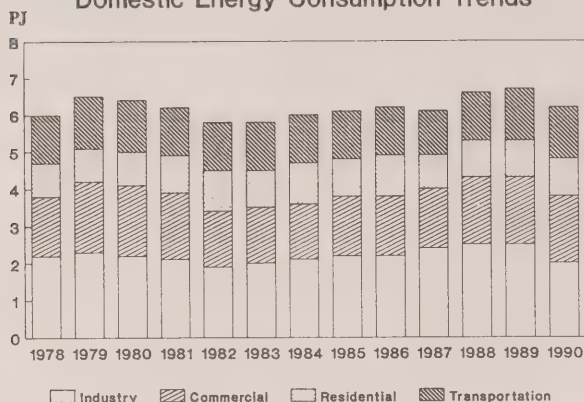
Type	Quantity	Terajoules	Percentage
Natural Gas m ³	3,265,808,947	494,030	34.5
Electricity MWhr	74,414,567	291,634	20.4
Liquid Petroleum:			
Light Oil m ³	282,705	11,208	.8
Heavy Oil m ³	3,716,745	155,558	10.8
Diesel m ³	369,276	14,681	1.0
Gasoline m ³	25,530	922	.1
Coal tonne	1,714,517	55,036	3.8
Coke tonne	3,763,648	87,693	6.1
Petroleum Coke tonne	2,584,334	60,215	4.2
Steam	n/a	23,366	1.6
LPGs tonne			
Other Fuels	n/a	211,120	14.7
Totals		1,430,238	

*All sectors' electricity converted at 3.6 MJ/kWhr.

marginal energy costs. The eastern wood industry, pharmaceutical, industrial machinery and farm equipment manufacturing sectors no longer participate in the surveys for much the same reason.

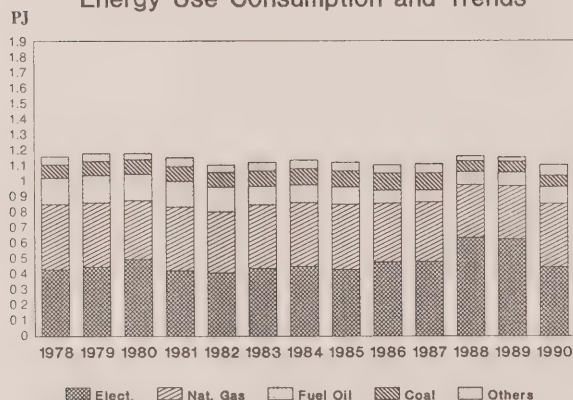
CIPEC trends show conditions in the largest, energy-intensive, processing type operations. Compared with the broader base of manufacturing companies in the Statistics Canada database, CIPEC

Figure 2
Domestic Energy Consumption Trends



surveys display a number of important differences. For example, CIPEC surveys focus on real (non-economic) operating and efficiency trends and gather information on use of waste fuels. Although the proportions of energy used are somewhat different than published by StatsCan, comparison of overall data is, nevertheless, still valid.

Figure 3
Energy Use Consumption and Trends



Energy Use Trends

The proportions of CIPEC surveyed energy consumption have changed each year since monitoring began in 1978 because of:

- changes in the reporting population
- shifts in industry composition
- effects of government and utility substitution programs, price and contract incentives
- changes in process technology
- restrictions in deliverability of fuels
- installation of cogeneration facilities
- impact of weather patterns
- preference for secure sources
- environmental benefits

Table II shows the sector trends while the graphic on page 1 shows the CIPEC composite trends since monitoring began in 1978.

Electricity

CIPEC participants used 76,414 GWh of purchased electricity in 1990 which is 42% of the total reported by Statistics Canada (SC 57-003). Additional power cogenerated by CIPEC firms is not identified although the fuel used for this purpose is included in other categories. The extent of monitored electrical coverage in the energy intensive industries ranges from 82% in the highly concentrated petroleum refining sector down to 37% in the diverse and scattered mining group.

Electricity provides 20.4% of the total power in the CIPEC group of companies with the highest percentage used by wood products (52%) and the lowest (5%) in the petroleum refining sector which self-generates much of its own electrical power. StatsCan reports a composite figure of 32% for all of industry, which includes a higher proportion of electrical use in small companies.

The trend to greater use of electricity consumption appears to have peaked at 30.1% in 1987 and is now in decline throughout the CIPEC group. Escalating prices, reduced production demand in the electricity-intensive sectors and utilities' switch from consumption incentives to promotion of conservation appears to be having an effect on this demand. The most noticeable change is in Quebec where Hydro

Table II

Distribution of Energy Consumption (percentage)

	Electricity			Natural Gas			Liquid Pet. Products			Coal & Coke			Steam			Others		
	'90	'85	'80	'90	'85	'80	'90	'85	'80	'90	'85	'80	'90	'85	'80	'90	'85	'80
Chemicals	10.8	9.5	8.3	52.1	56.2	54.4	2.0	7.3	19.1	0.4	0.1	2.3	2.2	2.0	1.0	22.5	25.2	15.0
Electrical & Elect.	38.2	33.5	31.5	58.0	63.6	57.3	1.6	1.4	9.5	-	-	-	1.8	1.5	-	-	1.5	-
Ferrous Metals	7.9	7.3	5.9	11.9	19.4	18.9	8.3	4.2	10.5	71.9	69.1	64.6	-	-	-	-	-	-
Food & Beverage	20.6	18.6	14.6	63.2	69.7	64.8	16.2	11.7	20.6	-	-	-	-	0.3	0.3	-	-	-
General Mfg.	34.2	28.1	26.1	53.7	60.2	52.9	11.4	11.5	21.0	-	-	-	0.1	-	0.1	-	0.1	-
Industrial Minerals	18.2	15.6	15.8	40.6	42.6	43.1	8.0	8.7	26.1	31.4	32.4	14.3	1.8	0.5	0.6	-	0.7	0.1
Mining & Metallurgy	34.1	41.2	39.5	16.2	25.2	18.6	32.0	23.5	36.5	9.5	9.9	4.5	8.2	n/a	n/a	-	0.2	0.5
Petroleum Refining	5.0	4.5	3.6	15.8	22.3	12.5	57.3	6.7	23.7	20.9	19.6	15.1	1.0	2.5	-	-	44.7	44.7
Plastics Processing	43.6	43.2	33.4	54.5	51.4	63.5	1.9	5.4	3.1	-	-	-	-	-	-	-	-	-
Pulp & Paper	36.8	44.9	29.1	31.8	26.1	25.5	30.1	25.8	41.3	1.3	2.9	3.0	-	-	-	-	0.3	1.0
Textiles	29.5	29.1	22.0	56.3	55.0	27.2	14.2	15.8	49.1	-	-	-	-	-	-	-	0.1	1.7
Transportation (Mfg.)	33.7	30.1	23.6	54.8	55.2	49.5	2.8	3.7	16.2	8.7	11.0	11.1	-	-	-	-	0.6	-
Wood Products	52.5	48.0	43.6	47.5	52.0	45.3	0.0	-	11.1	-	-	-	-	-	-	-	-	-
CIPEC Totals	20.4	19.1	18.5	34.5	32.3	31.0	16.4	17.6	24.3	13.3	19.2	17.1	1.5	1.0	1.0	13.8	11.8	9.1

Quebec has cancelled consumption incentive contracts. Ontario Hydro is now promoting use of alternate fuels to replace electricity.

The estimated cost of \$3.9 billion for electricity constituted 51% of the overall energy expense in the surveyed companies during 1990.

The average rate paid by CIPEC companies was about 5.1 cents per kWh, although there is considerable variance because of different rate structures. In Ontario, where nearly 60% of electricity is generated by nuclear plants, the average industrial rate is 5.3 cents per kWh. Manufacturers in British Columbia, Manitoba and Quebec, with a high percentage of hydraulic generation, enjoyed the lowest rates at 3.6 cents per kWh.

Canada-wide electrical cost rates have escalated 4.5% per year since 1985. Ontario Hydro rates will jump by 11.8% in 1991 while Quebec rates are scheduled to increase 14.5% in the next two years. Manufacturers in other provinces will likely see similar price increases as utilities factor in their escalating costs.

Electricity consumption has become the prime focus of industrial energy management because of the

rate of increase in prices and difficulty of substitution.

Natural Gas

The impact of the economic downturn is reflected in natural gas consumption. In 1990, industry used 32% of the total Canadian consumption and only 27% in 1982. This compares to a peak of 34% in 1987 when industry was stronger.

CIPEC reporting companies used 58% of the total 22.6 billion m³ consumed in the total manufacturing and mining sector in 1990. About 80% of the CIPEC consumption is used as fuel while the remainder serves as feedstocks in the chemical sector.

The CIPEC monitored use is slightly less than total residential and farm consumption (14.2 billion m³) but more than commercial use (10.1 billion m³) and nearly 4 times the amount used in the transportation sector. The chemical industry is the single largest consumer using 3.8 billion m³.

Industry's annual consumption of natural gas varies moderately with changes in product demand, weather and seasonal substitutions by other fuels.

Petrochemical feedstock conversions from offshore oil to domestic natural gas have also had a significant effect on recorded consumption. Manufacturing's demand has risen 23% in the last 10 years while mining's increase is less at 14% because of its greater reliance on fuel oil.

Industry uses large amounts of natural gas to generate electricity for itself and neighbouring town sites. In 1990, some 846 million m³ was used for this purpose which amounted to one-third of the total demand. Several large CIPEC firms are now in the process of installing new cogeneration facilities to lessen their dependence on local electrical utilities as well as reduce the impact of Time-Of-Use electrical rates.

Industrial natural gas prices across Canada, according to the Cansim (PNGINCA), averaged 9.06 cents per m³ (\$2.43/GJ) in 1990. This is down from 9.11 cents per m³ in 1989 and the peak of 12.56 cents per m³ in 1984 just before gas deregulation. Manufacturers in Alberta enjoyed the lowest prices at 4.74 cents per m³ while Quebec manufacturers had the highest at 14.99 cents per m³. Industrial rates are 39% lower than commercial rates and nearly one-half the residential rates.

According to the National Energy Board, natural gas prices are expected to triple by the year 2010 because of shrinking production surpluses. Greater demand in Midwest U.S. non-interruptible consumption for generating electricity will be one of the chief reasons for the smaller surpluses.

Petroleum Products

Industry's fuel oil consumption amounted to 9.6% of the 3,509 PJ of total domestic demand in 1990. The transportation sector is the largest consumer with nearly one-half of the total domestic demand. CIPEC reporting companies' use of 182.4 PJ accounts for 54% of the total industry demand.

Within the surveyed companies refined petroleum products supply only 16.4% of the total which is down significantly from 24.3% in the past decade. Two-thirds of the reduction is due to substitution by cheaper natural gas and one-third by displacement with no-cost waste fuels. Statistics Canada also shows an equivalent share of 16.4%. Every province is well above this average percentage, except Ontario, which relies on oil products for only 9.7% of its total energy.

Industry uses small (1.6%) amounts of propane as fuel in spite of the wide fluctuations in prices, which nearly doubled to approximately \$83.20 per m³ in 1990. Propane is used in preference to oil where natural gas is unavailable. Quebec and British Columbia manufacturers increased usage in 1990 while others reduced consumption.

The estimated cost of refined oil products was \$896 million throughout the CIPEC firms. Retail domestic heating oil prices, the largest component, averaged 34.7 cents per litre with +/- 20% variation across the country, according to Cansim (PLFDPCA). Prices have been quite stable since 1982 except for brief surges caused by the Persian Gulf war and other isolated events.

Coal and Coke

Companies in the CIPEC survey consumed 4.7 million tonnes of coal and 2.5 million tonnes of petroleum coke during 1990. The largest users were the steel makers, who transformed 3.5 million tonnes of coal into coke for their blast furnaces. Cement and lime making companies used one million tonnes of bituminous coal for kiln fuel.

Electric utility generating companies' coal consumption of 42 million tonnes was down from 46 million tonnes in 1988, partly due to reduced electricity demand and energy conservation by industry.

Industry's reliance on coal has steadily declined from the peak of nearly 21% in 1986 to 13.3%, because of reduced demand for steel products and displacement with cleaner-burning natural gas. Deregulation of natural gas contracts in 1985 helped lower prices to compete with coal which cost about \$85/tonne (\$2.65/GJ) in the two largest manufacturing provinces, Ontario and Quebec.

Industry's future use of coal may decrease even more because of the burdensome environmental impact of this carbon-rich fuel. Cement companies are still trying to convince environmental agencies that substitution with municipal refuse has positive environmental benefits, as well as needed cost savings.

Other Fuels

The "other" category includes a diverse mix of combustible wastes such as refinery off-gases, slops, bottoms, fish oil, used lubricants, etc. Unfortunately, there is no accounting of the tremendous quantities

of other combustibles such as packing crates, used pallets and other miscellaneous wastes.

Recovery and reuse of expensive hydrocarbons is largest in the petroleum refining and chemical companies. In these sectors, companies are improving their systems to minimize environmental emissions. Instead of flaring, more companies are cleaning and recycling waste streams back into feed lines.

A small number of general manufacturing companies now sell solid wastes to incineration companies but this is not yet a common practice. Disposal (tipping) costs can amount to \$150 per tonne in the Toronto area. The mounting crisis in landfill site use is also causing more companies to study or expand disposal facilities.

Still, the actual use of wastes is thought to be greater than the 11% to 13% level annually reported by CIPEC companies. The pulp & paper and wood products industries are undoubtedly the largest users of nonrecorded wastes. In these instances, spent liquor and hog fuels are the main sources but are difficult to consistently measure and quantify.

It is expected that much greater recycling of materials and products and industrial use of wastes as fuel will be made in future. Attention to this overlooked potential may rival the efforts now directed to conservation of electricity and traditional fuels. The value of wastes as a fuel have been well known for many years. The problem is convincing the environmental regulatory bodies that these wastes can be used safely for a common good.

Weather and the Environment

Variable weather patterns have had a significant impact on industrial energy consumption and the use for each type of energy. For instance, across Canada in 1990, the average heating degree-days were 10% less than in 1989 and 11% less than 1985's when the CIPEC companies set their reference energy-equivalent consumptions. But 5% higher than normal cooling degree-days in industrialized Southern Ontario in 1990 added to building air conditioning and process refrigeration loads to offset some of the seasonal heating cost savings. Thus, less fuel was consumed while more electricity was used. Even though

many surveyed companies commented on their regional weather effects, the overall impact is indeterminate because of practical limitations in the monitoring process.

In some cases, combustion systems on large steam generators, cat crackers and petrochemical reformers can adjust for variable weather conditions but these sophisticated installations are rare. In general, companies have been slow to install fully automated "feed-back" combustion control systems, fuel-air ratio controllers, low excess air burners, "free-cooling" refrigeration systems, variable head pressure refrigeration techniques, etc., because of the associated high capital and maintenance costs involved.

While better control and monitoring of combustion systems remains one of the highest potential sources of energy conservation and cost saving, the release of greenhouse emissions is now recognized as the major problem that requires government and industry attention.

The quantities of various emissions by CIPEC reporting companies are shown in Table II. Normal emission factors shown in Appendix A are those developed by Environment Canada. The emission factor for industry's electrical consumption is based on the fossil fuels used by each major utility and weighted according to the amount of industrial electrical consumption in each province. The conversion efficiency of generating electricity with fossil fuels was factored at 36%. The emission factor for the "other" category is a weighted composite of industry's primary fuels.

Canada's Green Plan already contains the concepts of how these damaging emissions will be monitored and controlled. Numerous studies are being done to determine the cost of this effort. One study, funded by a major Canadian oil company, suggests government will eventually impose a carbon tax of about \$55 per tonne on carbon dioxide emissions to counteract this rising problem.

International discussions on control of greenhouse gas emissions are also in progress. Representatives of Canadian industry are participating in the Canadian Council on Climate Change Committee to prepare Canada's position for a Heads-of-State "Earth Summit" conference in 1992.

Among the industrialized countries, most of the European Community, Japan and Canada favour stabilizing total future carbon dioxide emissions at 1990 levels. Britain and Germany think it is possible to gradually reduce emissions so that 2005's will be 20% lower than 1988's. The United States is against any stabilization or mandatory cuts because of the un-

known costs and consequences.

Whatever happens as a result of these international negotiations and eventual agreements, Canadian industry will feel the impact. Clearly, energy conservation and the need for greater operating efficiency has again become a major issue.

Table III

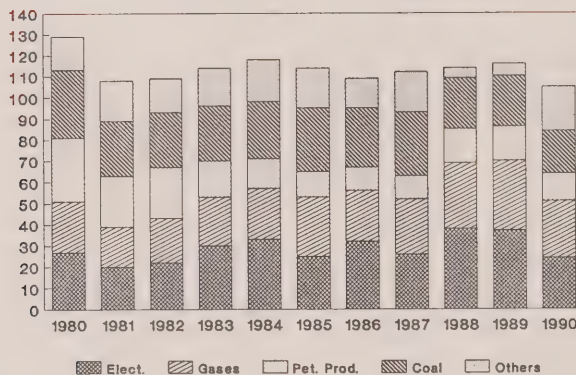
**Greenhouse Gas Emissions
CIPEC Reporting Companies
(tonnes)**

Energy Type	Terajoules	NOx	VOCs	SO ₂	CO ₂	Totals
Natural Gas	494,030	29,148	593	99	24,543,451	24,573,209
Electricity	291,634	32,151	194	186,303	24,183,499	24,402,147
Coal and Coke	202,944	50,736	253	295,882	18,691,183	19,038,053
Diesel	15,603	16,149	1,840	1,497	1,037,816	1,057,303
Light Oil	11,208	695	7	1,267	819,448	821,416
Heavy Oil	155,588	24,894	11,131	132,784	11,130,833	11,299,642
LPGs	24,740	1,484	1,484	0	1,480,496	1,483,465
Others	234,406	51,161	3,157	125,756	11,133,337	16,313,411
Totals	1,430,238	206,419	18,659	743,588	98,020,063	98,988,728

Environment Canada emission factors shown in Appendix B.

Figure 4

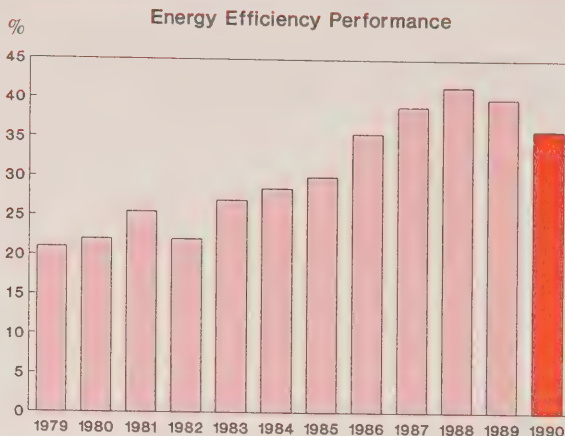
Carbon Dioxide Emissions



Chemical Industry

Energy Conservation Task Force

David Shearing
Chairman



Introduction

The information shown in this report comes from members of the Canadian Chemical Producers' Association (CCPA) which represents about 90% of the chemical manufacturing industry in Canada. About 80% of the CCPA companies' data are included in this survey.

The reporting companies range in size from those spending \$175 thousand to \$150 million per year for fuel and electricity. The approximate composition of this \$11 billion industry can be classified as two thirds petrochemical, one quarter inorganic and the remainder split between the organic and specialty sectors. Some industry sectors, pharmaceuticals, consumer products and nitrogen fertilizers are not included.

This survey accounts for nearly 308 petajoules of energy. That is equivalent to 60 million barrels of crude oil or enough crude to fill a 2 foot diameter pipeline 29,000 miles long. This sum is greater than the Statistics Canada estimates for the chemical industry because this survey includes a sizable quantity of waste materials used as fuel and a different mix of final products.

1990 Performance

Energy utilization declined 4.2% during the year and thus fell that much below the 40% improvement target set for 1990. Nevertheless, this unusual negative performance comes when management is redirecting its attention to new energy conservation activities. As well, environmental concerns have become the major driving force in many energy management programs. The reemergence of energy awareness committees, a

flurry of auditing activities including cooling water systems, long-term strategic site assessments, installation of low NO_x gas burners, etc., are signs of rejuvenating programs.

1990 performance, however, was affected by several business-related issues that worsened during the year and certainly were not foreseen when the efficiency target was set 5 years ago. In particular, the general effects of the 1989-1990 recession were not foreseen.

Recessionary economic conditions caused business profits (before taxes, interest and special writeoffs) to slip to \$1,002 million from \$1,855 million in 1989 in CCPA companies. Profits are expected to decline further in 1991.

Given these adverse conditions, companies operated with tighter budgets, again trimmed operating expenses, cut discretionary projects, mothballed some old plants and postponed major maintenance. Reports of the permanent shutdown of several inefficient units were noted in 1990. A few unplanned outages were also reported. As well, the slack times in some companies were used to debottleneck existing plants for better future performance, but these benefits are not always immediate.

Energy performance was thus hurt by a significant decline in capacity utilization, which according to the Statistics Canada method slipped to 89% from the 93% level in 1989 and 1988. In the 1982 recession, capacity utilization slipped deeply to the 64% level because the industry was then coming off a major expansion cycle. Though conditions in 1990 were more predictable and controlled, some companies especially noted the impact because of their

high base-load energy requirements and having to keep unused equipment protected against corrosion and freezeup.

It usually takes capacity use levels above 90% to prompt expansion. With utilization levels falling, capital investments tend to be directed into the "sustenance" category which is often simple in-kind replacement of existing equipment and machinery.

The widespread concern for the environment has also had a variety of impacts on energy performance judging from the number of comments in this year's survey. For example, one company's installation of a glycol recovery unit is saving a significant amount of material and disposal cost but uses more energy. On the other hand, another company reported recovery of large amounts of additional heat from its new waste material incinerator. In any case, there is agreement that environmental projects are getting the bulk of capital investment compared energy-related retrofits.

Even though new capital investment of \$2,938 million throughout the industry (\$984 million in the CCPA surveyed companies, excluding maintenance) rose 30% more than 1989's and 56% over 1988 spending, only about 3% of this was used for specific energy¹ retrofits. Of the \$2,938 million total investment, \$1,698 million (up 43% over 1989) went into new machinery and equipment while a steady \$615 million was spent on maintenance. Both categories of investment normally provide future efficiency benefits but the high levels of recent spending were clearly not enough to support 1990's energy efficiency performance.

Apart from business affecting improvements, the number and scope of technical improvements have diminished in the past 5 years. A common emphasis remains on improvement of steam systems. Several companies reported ongoing steam trap maintenance programs, additional insulation, installation of low NO_x burners, increased recovery of condensates, and recovery of low-grade heat. Companies are anticipating even tougher environmental emission restrictions and have decided not to wait for government intervention.

Electrical systems are also getting more attention particularly in Ontario, because of Ontario Hydro's Demand-Side Management promotional audits and

financial support. Several companies mentioned extensive conversion to high efficiency motors and installation of variable speed drives. New cogeneration facilities are being planned now because of better buy-back rates.

The way that chemical companies are now managed also has a profound effect on energy use and its performance monitoring both internally and in response to this survey. In general, stable energy prices and recent performance successes have gradually reduced the pressure on energy conservation programs. Routine monitoring and reporting have also been affected noticeably by changing ownerships, company decentralizations and management's strategy of shifting responsibility for energy efficiency down to the front-line operating level. In some of these instances the need for corporate performance monitoring and outside reporting has ceased altogether. In companies that have been privatized, performance results are sent only to their international head offices.

Much of the chemical industry itself is changing, which affects the way energy is used and monitored. For example, some traditional long life-cycle products are giving way to short-term products that are made in differently designed plants. A greater proportion of batch specialty plants are expected to be built in future. Substitutability of fuels and feedstocks, particularly in eastern Canadian petrochemical plants, is becoming a cause of concern.

With a new era of expensive environmental controls and escalating electricity prices looming (e.g., Ontario Hydro rates are expected to rise nearly 13% in 1991) energy conservation is expected to regain much of its former prominence. The above mentioned reemergence of awareness committees, fresh auditing, strategic energy use and overall site assessments, etc., are reminiscent of the energy management activities that took place when programs were formalized in the early 1970s.

Energy Consumption Trends

Table I shows that recovery of waste materials continues to grow. This trend is a result of past efforts to reduce the cost of purchased fuels and more now because of efforts to lessen the emissions of escaping gases into the environment. While no information exists on the Canadian chemical industry, the U.S. En-

1 Discussion Paper, Analysis of the Categories of Capital Investment, 1985-1987, Statistics Canada. J. Lacroix, November 1989.

Environmental Protection Agency (EPA) estimates that one-half the vent losses in U.S. chemical plants still come from leaking packing glands, seal tanks, compressor shafts and the like. One Canadian company reported this year that it had installed a major feedstock purification system to raise the quality of the gases to help process conversion efficiencies and lower venting losses.

Previous surveys also found that wastes are being recovered and purified for resale, but when this happens, they are not counted as fuels.

The group's increasing share of natural gas reflects not only the shift of the petrochemical in-

dustry closer to cheaper feedstocks and fuels in Alberta, but also a strategy to increase the flexibility of oil-based feedstocks in eastern Canadian plants. These plants can now operate on LPGs and LNGs when the cost differential between oil and gases swing past the optimum point.

Electricity consumption is also becoming a greater concern, primarily in Ontario, because of the possible shortage of dependable future supplies. One plant is therefore planning a 38.5 megawatt cogeneration unit for its site that would also supply half the electrical demand for the neighbouring town. The \$37 million project would provide a modest financial return in addition to reduced emissions of carbon dioxide.

Table I

Energy Use and Trends

Type	Quantities (,000)	Gigajoules	1990	1985	1980
Natural Gas	5,130,826 m ³	190,866,740	51.0	44.4	36.8
Electricity	9,243,364 KWhr	97,526,744	26.0	34.7	31.1
Liquid Petroleum Products					
Distillate Oil	69,583 litres	2,901,172	1.0	0.9	10.0
Residual Oil	78,096 litres	3,292,100	1.0	4.2	14.4
Diesel and Gasoline	11 litres	459	-	0.5	0.4
LPG (propane)	7,474 litres	198,816	-	1.0	-
Coal & Coke	51.4 tonnes	1,194,000	0.4	0.3	2.3
Steam	n/a	6,642,744	2.0	2.0	1.0
Others*	n/a	69,180,475	18.6	12.0	4.0
Totals	1990	371,803,250			
	1989	388,383,290			
	1988	381,712,677			
	1987	428,905,604			

*Others include process by-products, vent gases, drips, slops, pitch, sulphur, hydrogen, waste oils, etc.

Table II

Energy Efficiency Improvement²

Current Year (1990) Total Energy Inputs	371,803 Terajoules
Base Year (1985) Equivalent Energy Inputs	393,041 Terajoules
Adjustments (1985-1990)	430 Terajoules
New Improvement = 5.4%	

Efficiency Gain: 1973-1985	30.0%
1986	4.4%
1987	5.2%
1988	1.5%
1989	-1.6%
1990	-4.2%
Total Gain:	35.3%

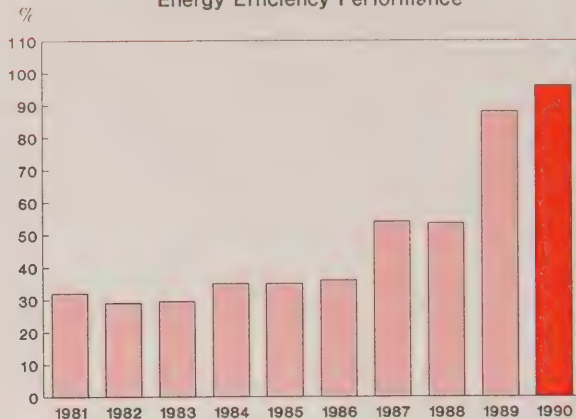
²Energy efficiency trends are determined from the participating companies' returns on the basis of the gross electrical conversion rate of 10551 kilojoules per kWh. Overall consumption figures are adjusted to a common reporting base to reflect the shifts in energy mix.

Electrical and Electronic Industry

Energy Conservation Task Force

Steve Horvath
Chairman

Energy Efficiency Performance



Introduction

In 1990, the Electrical and Electronic Industry's Energy Management Task Force closed the book on a decade of success in the energy field.

But at the same time, it opened the book on a number of new challenges on the need to rethink its role; and on the corresponding need to reorient industry, government and community attitudes to both energy management, and to the Canadian industry's track record in this field.

For many of the past ten years, the Electrical and Electronic (E&E) industry has recorded double-digit improvements in energy efficiency. It surpassed its own 45 percent improvement target in 1987, three years earlier than planned. For many years, it led all industry sectors in reported efficiency improvements. Since its inception in 1976 this Task Force has left its mark on both CIPEC and on the industry itself.

Although it did not record its usually high percentages in 1990, the E&E industry's 9.3 percent improvement in energy efficiency compares favourably with most other industry sectors. Total reported energy consumption dropped to 3.3 million from 4.9 million gigajoules the previous year, partly because of a reduction of reporting companies.

However, the relative distribution of energy sources remained fairly consistent with 1989 figures. Natural gas accounted for 58.0 percent of energy consumed, and electricity stood at 38.3 percent. The only change was in liquid petroleum products, where consumption fell back to 1987 levels of around one percent (in 1989, oil consumption had jumped uncharacteristically to more than seven percent of

energy consumed by E&E reporting members). Task Force members attribute this reversal to rising oil prices in 1990.

1990: A Year To Rethink the Future

The past year has been difficult for both the E&E industry and for Task Force members. The looming recession has forced the industry to tighten its collective belt. For Task Force members themselves, the major challenge in 1990 was to rethink its mandate and future. Two successful projects were mounted. A tour of Darlington and a review of the Ontario Hydro Demand Supply Plan each drew more than 40 company representatives. However, further plans to rebuild its educational profile were temporarily put on hold, largely because of members' preoccupation with business needs in the face of the 1990/91 recession.

The future of the E&E industry Task Force, and perhaps the future of CIPEC itself, will be driven by major changes in the Canadian economy, organizational structures and priorities. Key among these are the following:

- **The "slimming down" process continues unabated**

Global competition and a tight Canadian economy have forced companies to severely rationalize both product lines and operations. Diversification is on the way out. More and more companies are returning to their core business, and through amalgamation and joint ventures within their industry sectors are strengthening their position to weather the rocky 1991 recession and beyond.

For the Task Force, the impact of this corporate streamlining is two-fold: the member product base is continuously changing; and immediate business needs are demanding a higher priority than energy management considerations.

- **The energy manager today is a rare commodity**
Recession and rationalization have thinned the ranks of energy managers to the point where virtually none of the companies in the E&E industry Task Force employ a full-time energy manager. Instead, the energy manager's hat today is worn by the same individual responsible for safety, environmental issues, plant management or maintenance. Energy management thus is only one of the many issues on this individual's plate, and does not necessarily sit at the top of that individual's agenda.

- **Energy management is a "matter of course" for many companies**
In recent years, energy efficiency has become a necessity as companies drive to be more productive and competitive. Most members have completed the most obvious retrofitting projects that yield astounding improvements in energy efficiency. Today, the majority of improvements will be through the purchase of new more efficient process equipment. Improvements in energy efficiency will continue, but the gains will be more meaningful in a highly competitive global market.

- **The "greening" of organizations puts energy efficiency in a new light**
The heightened awareness of conservation in all areas of business and private life has helped to make energy management a way of life for many organizations. Companies today are buying state of the art equipment that is energy efficient and environmentally friendly; they are recycling materials and fuels in a number of innovative ways. The aim is to be an environmentally responsible corporate citizen; the result, often, is improved energy efficiency. Thus, in the drive to "green" their operations, companies have internalized the energy management function.

1991: A Year to Change Directions

In this kind of environment, change is inevitable. Faced with the need to change, Task Force members have identified two priorities for the coming year:

- **To position energy management as a sound business practice**

The Task Force will endeavour to make members more aware of the energy savings opportunities that exist in the process area, an area in which substantial improvements can be realized. As manufacturers of the majority of energy conserving equipment, the E&E industry is well positioned to drive this message home to both its own members and to other appropriate sectors of industry.

- **To put Canadian industry on an even reporting footing with the rest of the world**

Governments and major international organizations claim that Canadian industry is among the most consumptive, energy inefficient in the world today. Task Force members are concerned that the reporting base used to arrive at this conclusion may not represent the real picture; that in fact these organizations are not making fair comparisons, and may be painting an unrealistic picture of Canadian industry. These comparisons don't always appear to take into account the cold climate in which our companies operate, and the energy intensive nature of our industries (steel, pulp and paper etc.)

In 1991, Task Force members will work with other organizations and government officials to examine the possibility of conducting a study that would use "a level playing field" to compare energy consumption and efficiency of our industries with that of other major industrialized nations.

The pressures on our industry, and indeed on all Canadian industry, are many. To have external sources put unreasonable expectations on our industry to improve energy efficiency as a result of preconceptions or unrigorous measurement criteria, seriously undermines our already precarious global competitiveness. The challenge for the coming year, and the coming decade, is significant and crucial to our existence.

The more than 200 companies represented by the Electrical and Electronic Industry Management Task Force manufacture a diverse range of products used in the generation, transmission and distribution of electricity; examples include generators, transformers, lighting equipment, wire and cable and electrical appliances. Companies represented by this Task Force also manufacture a variety of electronic products, systems and related high technology components. The majority of these companies are members of the Electrical and Electronic Manufacturers' Association of Canada (EEMAC), which acts as a secretariat for the Task Force.

Table I

Energy Efficiency Improvement

Current year (1990) Total energy inputs		3,300,754 GJ
Base Year (1989) Equivalent energy inputs		4,023,362 GJ
Net Improvement		9.3%
Adjustments - None		
Efficiency Gain	1975 -1985	36.1
	1986	1.9
	1987	16.2
	1988	-1.2
	1989	34.7
	1990	9.3
Total Gain	1975 -1990	97.0%

Table II

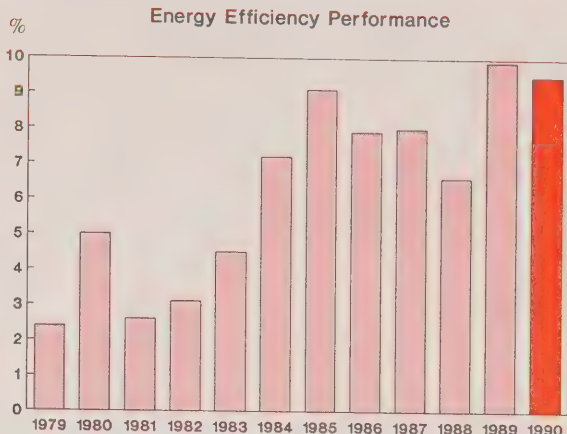
Energy Use and Trends

Type	Unit	Gigajoule	1990	1989	1988
Natural Gas	51,488,199 m ³	1,915,360	58.0	54.7	57.6
Electricity	350,717 MWh	1,262,583	38.3	35.1	36.7
Liquid Petroleum Products:					
Distillate Oil	348 kilolitres	13,586	0.4	2.5	1.0
Residual Oil	395 kilolitres	15,983	0.5	5.1	1.1
Diesel and Gasoline	117 kilolitres	4,696	0.1	0.3	0.2
Other Fuels:					
Propane	884 kilolitres	23,876	0.7	0.6	0.5
Steam	2,422,097 kilograms	64,670	1.9	1.7	2.9
Totals					
1990		3,300,754			
1989		4,023,362			
1988		6,273,070			

Ferrous Metals Industry

Energy Conservation Task Force

Denis Jones
Chairman



Introduction

The year 1990 has been difficult for the ferrous industry in Canada. Some of the items contributing to the difficulties include a combination of prolonged strikes in two of the major integrated Canadian steel producers, increasingly poor demand for steel products, a deteriorating economy, aggressive inroads by foreign steel producers into Canada, the high value of the Canadian dollar, high interest rates and government's policies which continue to maintain high budget deficits. These items have occupied management's attention and forced energy related activities to a lower position on the steelmakers' agendas.

Reporting Update

Traditionally, the energy statistics submitted for inclusion in the CIPEC report by the Ferrous Industry Energy Research Association (FERA) represented a high percentage of the Canadian steel output (up to 85 per cent). In computing the 1990 statistics for the CIPEC report, only three companies agreed to participate, representing approximately 50 per cent of the potential Canadian steelmaking capacity. The three participating companies are:

- Algoma Steel Corporation
- Dofasco Steel
- Sydney Steel Corporation

1990 Composite Energy Performance

All current and past statistics have been adjusted to reflect only the current reporting companies. For the

three reporting companies, steel produced was 5,348,579 tonnes for 1990. Total energy consumed was $121,951 \times 10^{12}$ joules.

The amount of energy consumed per tonne of raw steel was slightly lower in 1990 at 22.8×10^9 joules than in 1989 at 22.87×10^9 joules - a decrease of 0.4 per cent.

- Progress Towards the 1990 Energy Rate Goal.

The 1990 energy rate at 22.80×10^9 joules per tonne was 0.4 per cent lower than the 1985 base year of energy rate of 22.9, and 5.9 per cent higher than the 1990 energy goal of 21.56×10^9 joules per tonne.

Task Force Technical Activities.

Due to work stoppages at two of the companies participating in the CIPEC program, and the related reduction in manpower available to work on CIPEC tasks, many of the tasks and programs planned for 1990 did not take place.

In January, a senior representative from the International Flame Research Foundation Station, Ijmuiden, the Netherlands, updated CIPEC participants on the IFRF research in:

- Near Field Aerodynamic Advances
- Low NO_x Burner Development
- Mathematical Modelling Studies

A contract was awarded to develop and detail a combustion workshop based on the outline developed by the committee. The first of the two-day

combustion workshops was conducted at Sydney Steel in September 1990.

In February the Technical Committee met at the CANMET Metals Research Laboratories to hear an overview of the energy research program of the Mineral Sciences Laboratories (MSL) and the strategic study of future ironmaking processes.

1990 Energy Conservation Projects

The following lists some of the energy conservation projects undertaken in 1990 by CIPEC participating companies:

- Boiler Feedwater Economizer
- Blast Furnace - heating and natural gas rather than cold blast sensible heat.
- Reheat Furnace Air/Fuel Ratio Trim Control
- Boiler Station Excess Oxygen Trim Control
- Scrap Preheat in Steelmaking Vessel
- Replace Solution Mixer with High Efficiency Unit
- Eliminate Deaerator Venting on Steam Systems

Table I

Ferrous Metals Industry Energy Efficiency Improvement

Current year (1990) total energy inputs		121,951 terajoules
New base year (1985) equivalent energy inputs		122,482 terajoules
Gross Improvement	-0.4%	
Adjustments	None	
Efficiency Gains	1974-1985	9.1%
	1986	-1.2
	1987	0.1
	1988	-1.4
	1989	3.3
	1990	-0.4
Total Gain 1974-1990		9.5%

Table II

Ferrous Metals Industry Energy Inputs

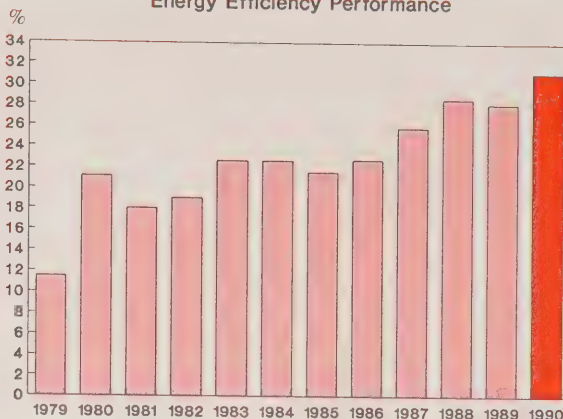
<u>Purchased Energy</u>	<u>Quantity (SI units)</u>	<u>Energy Terajoules</u>	<u>Percentage</u>	
			<u>1990</u>	<u>1985</u>
Natural Gas	388,360,220 m ³	14,447	11.8	10.6
Electricity	2,675,833,300 kWh	9,633	7.9	6.1
Residual Oil	250,493,830 litres	10,178	8.3	5.8
Coal & Coke	3,023,897 tonnes	87,693	71.9	77.5
Total purchased energy		121,951		

Food & Beverage Industry

Energy Conservation Task Force

Alexis L.W. Hyland
Chairman

Energy Efficiency Performance



Introduction

The 126 companies in this survey represent only the largest processing and manufacturing operations in this very diverse industry. Forty-one percent of the total industry energy consumption is covered in this survey.

Of the total 4,000 firms, about 90% are too small to monitor because of their small energy use and low energy intensities.

General Performance

Energy use improved 3% during the year, which was enough to attain the 31% goal that was set 5 years ago. The 1990 gain is mostly the result of several shutdowns of inefficient operations, tough recessionary strategies that focus greater attention on cost saving activities, and rapid adjustments being made to survive in the new Canada-U.S. Free Trade Agreement (FTA) environment.

The less serious negative effects of lower production levels, lower capacity utilizations, lower investment ratios, and leaner technical staffing would have had some effect, but these were not paramount, except in some individual sectors.

Total efficiency gains have slowed in the past 5 years to just under 2% per year compared to the earlier rate of 2.7% per year. Survey results show that productivity improvements are becoming more difficult and expensive to achieve. Many companies are postponing new investments.

Capital spending (\$1.97 billion) dropped 6.6% for new construction and machinery in 1990 after rising nearly 8% in 1989. Meanwhile, the investment

in maintenance was steady. Only a small proportion of this capital expense, about 3% according to last year's survey, is usually spent on energy improvements.

Energy conservation committees are starting to reappear in some companies to again focus attention on low-cost housekeeping and maintenance activities. These techniques are seen as effective ways of improve productivity without large capital expenditures.

Table I highlights individual sector performances. While the impact of the FTA has been more severe on food processing companies, all those in the industry have felt the effects of more intense competition sooner than expected. This has forced many companies to exchange or combine operations for economies-of-scale, and/or shut down and write off their least efficient smaller operations. Even so, falling capacity utilizations, which have steadily slipped to 81% in the food sector and 75% in the beverage group, do not reveal the extent of underutilized capacity yet remaining in some parts of the industry. This downsizing process is expected to continue and should help concentrate the group's efficiency.

Sector Performances

Bakeries

Except for the 2.5% efficiency decline in 1990, the 23% total gain has been a steady upward trend since the 1979 Base Year. Past optimization and new baking techniques are the primary reason for improvements. Total energy intensity for the various products in this group remains at 2,650 kJ/kg.

No significant energy management actions were noted this year as attention was directed to control of

production costs. Still, average energy intensity is about 16% higher than large U.S. operations where larger production runs are possible.

Consumption of electricity has grown from 13% in 1979 to 22% in 1990. Natural gas now supplies 62% of the energy.

Biscuit Manufacturers

Energy efficiency dropped 4.8% in 1990 following declines in the past three years. Average energy intensity is now up to about 5,900 kJ/kg of output.

Survey results show that few retrofits have been installed in the past three years and that most companies are relying on basic housekeeping and maintenance activities to sustain their energy efficiencies. When these activities are relaxed performance usually suffers.

Breweries

Aggregated energy efficiency has declined for a number of years and is now only 6% better than operating conditions in the original 1976 Base Year. Having to operate too many small local breweries to satisfy provincial trade regulations has not been conducive to the best operating efficiency. Energy intensities still average around 300 MJ/hectolitre for large plants and twice this amount in micro brewing operations. As a result, energy costs vary between 7% to 15% of direct factory expenses, depending on the size and location of each plant.

Two of the largest breweries merged in 1988 and this had a major impact on the consolidated results. As well, several micro breweries have become better established and now participate regularly in the survey.

Confectioneries

Total energy efficiency improved 16.2% in 1990 as a result of several product cancellations, shutdown of some inefficient sites, and general improvements to existing processes. For example, one company has installed economizers on its refrigeration equipment to vary the condensing head pressures and thereby take full advantage of cooler ambient temperatures in winter months. Installation of more efficient lighting and motors are popular in this sector.

Electricity now provides 35% and natural gas 62% of the total energy supply in the group.

Distilleries

The 4.4% decrease in energy utilization in 1990 is due to a further decline in production and consequent lowering (2.4%) of capacity use. Most plants report operating at a marginally efficient 75% capacity level. One plant was shut down in 1989 and another one is scheduled to be closed in 1991.

Energy intensity of distilled products averages 40,818 kilojoules per litre (absolute) throughout the sector.

Nearly all the surveyed companies show ambitious future improvement goals. Distillers tend to be quite progressive in keeping up with technology improvements and see increased productivity as a preferred means of maintaining profits.

Food Processors

Energy efficiency slipped less than 1%, which lowers the total gain since 1976 to 22.7%. Energy performance is muddled by a variety of mixed business conditions in this group with some companies increasing production and installing new equipment while others are shutting down because of thin profits. Aggressive use of provincial energy auditing programs and electrical utilities' Demand Side Management programs is a growing occurrence. Some new technologies, e.g., ultra filtration and membrane technology are seen as ways to lower energy intensities.

Fisheries

Energy efficiency gained 1.2% in 1990, which helped raise the gain since 1985 by 20.2% and 26% from the 1978 Base Year. While general business conditions have improved somewhat - GDP rising 5.5% in 1990, for example, better utilization of severely rationalized operations has been the main reason for the productivity gains.

Grocery Products

Energy utilization gained 2.6% during 1990 on the strength of some reported process modifications and modest factory improvements, for example, plant lighting, etc. The sector's GDP rose 5.2%, suggesting some volume increases although several plants reported operating at capacity utilizations as low as 50%.

Two-thirds of the 33% total gain was achieved between 1978 and 1985. Recent gains, while steady, are slowing because of reported higher implementation costs. Companies in this group are up-to-date on use of energy efficient equipment.

Meat Packers

The 2.8% decline in energy utilization dropped the total gain below the 40% level that had been achieved up to 1985. While most of the larger companies are reverting to basics with reductions of excess capacity, leaner organizations and fewer products, many of the smaller companies are shutting down. Performance was very mixed because of turbulent business changes. Some energy improvements were reported, e.g., additional water heat recovery, refrigeration system enhancements, switch to high efficiency electrical motors, etc., but the benefits are not widespread throughout the industry. Increased environmental control costs are also competing for available capital funds.

Poultry and Egg Processors

Energy utilization improved 8.8% in 1990, mostly as a result of 6.8% production increase. According to several reports, capacities are at peak rates. As well, companies are taking advantage of provincial energy audits to identify new improvement opportunities.

The egg and egg product firms still have low energy intensities in the 4500 kJ/kg range with energy about 1% of cost-of-shipments. The poultry processors have higher intensities, often with energy costs up to \$150,000 range which are about 6% of manufacturing expenses. In some plants, refrigeration systems that maintain whole factories at 50°F and warehouses at 33°F are the main users. In others, extensive hot water systems are the chief energy consumers.

Soft Drink Producers

Those surveyed in this group report a total gain of 3.8% in energy efficiency in 1990. Several of the reports note that plants will be closed in favour of new larger facilities. About half the energy is used for plant HVAC and the other half for processing, sterilizing, and materials handling.

This industry uses as much energy as the distilleries and half as much as the breweries. Energy intensities are in the 3,500 - 4,000 kJ/litre range for bottlers and 1,500 kJ/litre for canners.

Sugar Refineries

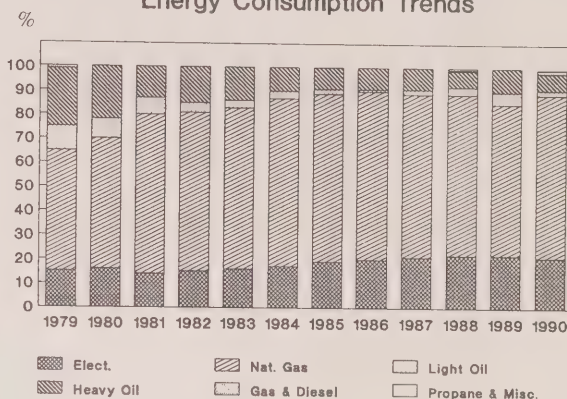
Performance dipped 1.5% because of minor production slowdowns that lowered capacities to less than top rates. Overall efficiency is still 45.9% better than 1975 operating conditions with energy intensities in the 3500 kJ/kg range. Refiners are still reporting increased efficiencies, however, with further improvements in steam and condensate systems, optimization of heat exchange systems based on pinch technology analysis, process changes, and application of high efficiency electric motors and peak controllers.

Wineries

Results of energy use in Canadian wineries are too sparse to monitor because, having the lowest energy intensities in the food and beverage industry, energy is not a major concern. Energy costs usually amount to just 1% of the value of shipments in this group. Even so, refrigeration systems are operated most efficiently because close attention is necessary for product quality.

Figure 2

Energy Consumption Trends



Energy Use and CO₂ Emissions

Improved energy efficiency is generally recognized throughout the industry as a major way to reduce the harmful effects of greenhouse gas emissions. Significant improvements have already resulted from switching to less carbon rich fuels and more efficient energy use.

Analysis shows that about 3,578,870 tonnes of CO₂ were discharged into the atmosphere by the surveyed companies from the 64,974 TJ consumption reported in 1979. The group's emission rate was equivalent to 55.08 tonnes/TJ of energy consumption. However, in the past eleven years of monitoring, the shifting energy mix has lowered the CO₂ emission rate nearly 6 t/TJ to the current level of 49.1 t/TJ.

As well, improved energy use (20.5% since 1979) has coincidentally lowered the CO₂ emissions rate 14.1 t/TJ. The total reduction rate of 20.1 t/TJ therefore represents a 3.9% per year environmental improvement rate. It is doubtful this rate can be maintained, however, partly because further fuel switching is unlikely and future energy improvements will be more expensive to carry out. Nevertheless, the definite linkage between environmental emissions and energy use will be closely monitored in these reports.

Table 1

Sector Performance

<u>Sector</u>	<u>Original Base Year</u>	<u>Consumption TeraJoules</u>	<u>1990 Eff. % Change</u>	<u>1985-1990 % Change</u>	<u>Total % Change</u>	<u>Estimated Cost (\$MM)</u>
Bakeries	1979	1,073.2	2.5	11.3	23.3	9.29
Biscuit Mfg.	1979	1,052.	14.8	6.8	16.4	8.23
Breweries	1976	8,004.5	2.6	0.7	6.0	59.05
Confectioners	1981	1,588.8	16.3	15.3	41.0	14.76
Distillers	1977	5,961.5	-4.5	8.1	25.8	37.93
Fisheries	1978	1,361.7	1.2	6.3	26.5	12.39
Grocery Prod.	1978	4,526.5	1.1	9.9	33.3	35.87
Meat Packers	1978	3,218.1	-2.8	-1.5	38.5	27.60
Poultry and Egg	1982	809.6	8.2	3.5	11.8	9.43
Food Processors	1976	4,991.0	-0.5	6.2	22.7	35.62
Sugar Refiners	1975	2,534.9	1.5	17.6	45.9	9.2
Soft Drink Prod.	1988	1,318.8	3.8	6.0	6.0	0.93
Wineries	1988	n/a	n/a	n/a	n/a	n/a
Totals	1977	36,442.3	3	9.8	31.3	275.71

Table II

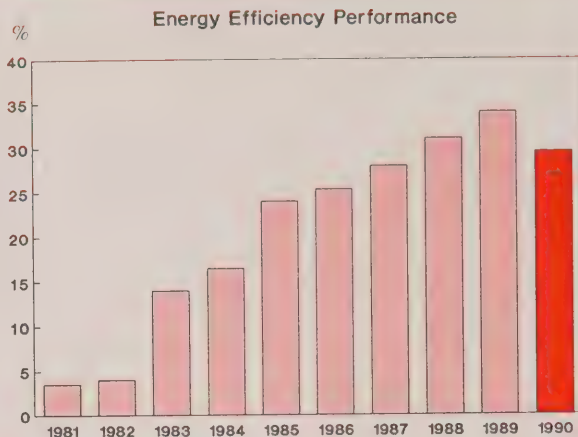
Consolidated Energy Use, Trends, and Emissions

<u>Energy</u>	<u>Quantity</u>	<u>Terajoules</u>	<u>Proportions (%)</u>		<u>CO₂ Emissions</u>	
			<u>1990</u>	<u>1985</u>	<u>1979</u>	<u>tonnes</u>
Natural Gas	620,177,663 m ³	23,070.6	65.4	69.78	50	1,184,893
Electricity	2,084,401 MWh	7,503.8	21.29	18.54	15	269,024
Liquid Petroleum Products:						335,543
Light F.O.	44,708,489 litres	576.4	1.64	1.19	10	
Heavy F.O.	71,563,757 litres	2,851.0	8.09	9.53	24	
Diesel, Gasoline	21,025,239 litres	825.5	1.97	0.17	1	
Steam	n/a	1.7	n/a	n/a	n/a	
LPG, Propane	15,438,823 litres	410.7	1.17	0.5	0	
Miscellaneous	n/a	10.7	0.37	0.29	0	
1990 Total Consumption		35,250.3 Terajoules				1,789,160
1985 Base Year Equivalent Consumption		39,054.0 Terajoules				
Efficiency Improvements						
		1977-1985	21.5%			
		1986	1.2%			
		1987	3.1%			
		1988	2.8%			
		1989	-0.5%			
		1990	3.0%			

General Manufacturing

Energy Conservation Task Force

Bent K. Larsen
Chairman



Introduction

This survey profiles the energy management trends and concerns from a variety of general manufacturing companies. For annual monitoring the companies have again been segregated into light manufacturing, metal fabrication, and continuous processing. The combined results provide a good picture of general conditions throughout the manufacturing industry.

The cost of energy in the participating companies ranges from \$100,000 up to nearly \$28 million. About two thirds of those surveyed have moderate energy costs in the \$500,000 to \$700,000 range. Even though energy costs usually average about 5% of manufacturing expenses, energy remains a significant concern throughout this sector. The estimated total cost of fuel and electricity for the participants is \$143 million at an average cost of \$7.55 per gigajoule.

It is not possible to claim a percentage of sector coverage because of the loose definition of general manufacturing and the speed of business changes occurring throughout the industry.

General Performance

While energy utilization declined 1.8% in 1990, the average energy intensity level has been improved by 6.2% since 1985. Results show performance has risen 29.6% since 1979. This overall performance result did not achieve the 33% target figure that was set 5 years ago but is considered satisfactory in view of the impact of unforeseen events that have occurred during the past 5 years.

About half the participating companies did not specify any future performance targets. Of the other

half, most foresee only nominal performance increases of about 2% per year. Four companies reported ambitious 10% per year performance goals for the next three years.

Metals Group

The metals group, composed mainly of energy-intensive foundries, forging shops, tool manufacturers and the like had a 1.2% improvement in energy efficiency which boosted the overall gain to 23% over 1982 usage. Natural gas provides the biggest share of energy at 56% with electricity next at 38%. Some modern foundries in Quebec use only electricity for power. This is the only group that reports use of waste fuels (1.2%) to supplement the small consumption of other fuel oils.

Light Manufacturing Group

This group's average performance declined 4.5% during the year. Energy use has improved 18.3% since 1984 however. The most significant reason for this year's decline was reduced consumer demand which lowered manufacturing's production and capacity utilization by 5.3%. Companies in this sector tend to have relatively high base-energy loads, for example, HVAC, etc., which make energy efficiency very sensitive to changes in production and capacity use.

Factory automation, which is increasing, also uses more energy per unit of output and results in greater use of electricity. The electricity share is now up to 29% from 26% in the past decade. Natural gas now supplies 65% of the total, petroleum products 2.9%, and others, which consist mainly of purchased steam, supply a nominal 2.3%.

Processing Group

This group, most of which make a variety of rubber products, has seen a recent slide in performance results because of decreasing production levels and slow investment in new facilities. The group's energy use dipped 1.7% during 1990, 2.5% in 1989, and 3.2% in the previous year. Overall efficiency, however, is 38% greater than the 1978 average because of large gains made between 1982 and 1985.

The electricity share has slowly risen to 32% since monitoring began while petroleum products have shrunk to 33%. Natural gas provides 34% of the total energy.

General Analysis

General performance during the past eleven years shows the impact of different business conditions on energy performance. During the '81-82 recession, for example, manufacturing companies first cut back production to trim inventories and satisfy short-term sales forecasts. At the same time, business strategies were revised. Greater productivity became a need for survival. Energy usage remained flat when production was severely cut back (16%) even though many inefficient sites were shut down and energy conservation programs were revitalized.

The fastest annual rates of energy improvement followed the 1982 recession. Energy efficiency jumped ahead by 10% in 1983 when production output increased instead of shrinking as it did in 1982. Capacity utilization in the durable-goods sector had sunk to 58% in the third quarter of 1982 (only to 77% in 1990). With improving business conditions in the next six years, energy efficiency saw corresponding increases.

Business conditions were much different in 1990, however. Most companies were making basic changes to survive not only the current recession but also the sweeping impact of increased foreign competition. By 1990 many firms had become much leaner and had shrunk back to core operations. Capacity utilization declined only 4.7% but this was harder because of the reduced excesses. Consolidated energy efficiency trends were negative because more participating companies reported declines than increases.

Closer analysis of the production-related effects reveal that almost two-thirds of the overall efficiency gains have come from product changes including material substitutions, etc. This was determined from statistical regression analysis of the relationship be-

tween energy efficiency, production output, capacity utilization, and other secondary influences such as energy prices. Capacity use, which is less now than it was in 1979 when monitoring began, has depressed overall efficiency by 7%. The influence of increased energy prices was negligible. The one-third remainder of the measured efficiency gain, disregarding the negative effects of capacity, is therefore attributed to technological improvements. This final net component represents the extent of improvement in facilities and equipment, retrofits, better procedures and maintenance, etc.

The above key sources of efficiency gain should be appreciated when it comes time to set future performance standards and goals - especially when energy efficiency gains are linked with reduction of greenhouse gas emission targets.

Energy and the Environment

Surveyed companies were asked to provide their initial response to possible government initiatives that relate to reduction of greenhouse gas emissions. In future, it is recognized the efficiency and purpose of energy consumption will likely be subject to very close scrutiny.

The following potential items are simply ranked on a scale of (1) strongly against, (2) somewhat against, (3) undecided or neutral, (4) mildly support, and (5) strongly in favour. In general, those items with the highest average score also had the greatest level of agreement. The opposite was shown for the low ranking items.

Of all the items listed, technical information news and seminars were thought to be the most effective technique for helping to improve energy efficiency, and in turn, to reduce environmental emissions. The least effective method was government intervention in energy prices. Anything to do with mandatory requirements, e.g. efficiency targets, inspections, reporting, etc., drew the least applause and widest disagreement.

Table I

Environmental Considerations	Average Score
"Polluter Pays" Principle	3.97
Effluent Charges	3.69
Emissions Trading Scheme	3.32
Mandatory Performance Inspection	3.00
Government Energy Price Intervention	2.55
Energy Related Considerations	
Retrofit Tax Allowances	4.39
Financial Grants	4.28
Low Interest Rate Loans	4.25
Minimum Equipment Standards	4.03
Minimum Facility Standards	3.97
Minimum Process Standards	3.82
Mandatory Energy Efficiency	3.21
Government-Industry Cooperation	
Energy Efficiency Information	4.55
Technical Transfer Seminars	4.33
Continued Voluntary CIPEC Program	4.18
More detailed CIPEC Reporting	4.00
Energy Monitoring Software	4.00
Energy Performance Awards	3.76
Special Training Centres	3.52
Voluntary Technical Audits	3.38
Electronic Bulletin Boards	3.03

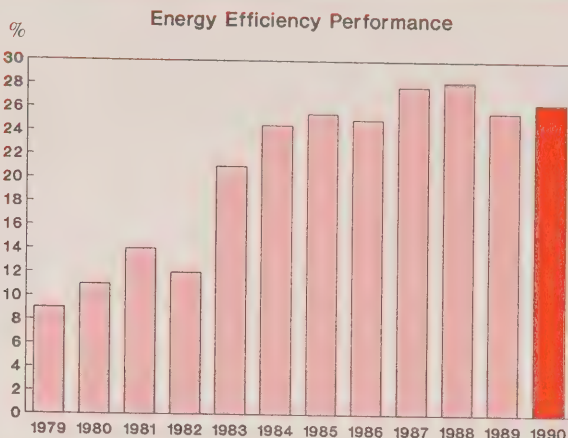
Table II

<u>General Manufacturing Industry</u>					
Energy Use		Gigajoules	Percent Distribution		
Type	Units (,000)	(10 ⁹)	1990	1985	1980
Natural Gas	275,205 m ³	10,237,660	53.8	60.2	52.9
Electricity	1,810 MWh	6,518,010	34.2	28.1	26.1
Liquid Petroleum Products					
#2 Oil	9,336 L	364,117	1.9	1.2	1.8
#6 Oil	34,995 L	1,302,641	6.8	9.6	5.9
Diesel	1,984 L	79,198	0.4	0.4	2.3
Gasoline	1,955 L	70,779	0.3	0.1	0.7
Other Fuels					
Propane	8,329 L	221,572	1.2	0.3	0.2
Steam	n/a	130,751	0.7	0.2	-
Others	n/a	108,673	0.6	0.1	0.1
Totals		19,033,400			
1985 Base Year Equivalent Consumption:		20,293,590 Gigajoules			
Net efficiency 1985-1990		6.2 %			
Energy efficiency gain 1981 to 1985		23.4 %			
1986		1.9 %			
1987		3.8 %			
1988		3.0 %			
1989		-0.4 %			
1990		-1.8 %			
Total energy performance improvement:		29.9 %			

Industrial Minerals Industry

Energy Conservation Task Force

Mr. John M. Lind
Chairman



Introduction

The Industrial Minerals group consists of 9 different sectors that mine, process and/or manufacture a variety of non-metallic products for later use in the construction and steel making industries. The combined GDP of this industry amounted to \$13.2 billion in 1990.

This survey represents 75% of the total energy consumption in the industrial minerals industry. Nearly 95% of the cement industry is included. In the medium energy-intensive sectors, abrasives, asbestos, glass and lime, about 75% of the total energy consumption is surveyed. In the less energy-intensive groups, which consist of some 1200 companies, about 20% of companies are represented.

General Performance

Energy efficiency has varied by small amounts in the past 5 years resulting in a net gain of only 1% since the 1985 reference levels. 1990 performance was up 0.6%. From the original 1977 Base Year, overall performance had increased 25.4%, but fell short of the 35% target set for 1990. The annualized improvement rate of 3.1% per year was achieved in the early years of monitoring when incentives and business conditions were more favourable.

1990 performance was affected by a severe downturn in the construction industry which reduced cement production volumes by 6.5%, concrete products output by 12% and redi-mix concrete business by 23%. Production volumes in other sectors were down by lesser amounts. Group capacity utilization thus slipped from 77% in 1989 to under 76% in 1990.

Very little of the total efficiency improvement has come from new or revised processes in this industry. Most of the manufacturing processes are very mature and not subject to major changes. There is improvement potential, however, as noted below in the individual sector reports. Maintaining the effectiveness of equipment insulation, heat recovery, closer control of combustion systems and electrical demand are common opportunities for energy conservation throughout the industry.

Sector Reports

Abrasives

Abrasive manufacturers' energy performance dropped 2% in 1990, primarily because of a 6% drop in production. The total gain since 1982 is 12.4%.

The energy intensity of silicon carbide products ranges from 12,000 to 14,000 megajoules per tonne of output - depending on furnace configuration. Raw aluminum oxide requires 10,000 MJ/tonne to make. The surveyed companies' energy mix is still 88% electricity and 12% natural gas. High efficiency motor replacements and careful load scheduling are popular energy management items.

Asbestos

After several years of reduced market demand and industry rationalization, 1990 was a good year with 3.3% increased efficiency. Energy intensity averaged about 6,570 MJ/tonne of processed raw fibre throughout the industry, but there was wide variation because of the different quality of fibre.

Companies are forecasting energy efficiency improvements between 2% to 5% per year up to 1995. The British Columbia mine is switching from an open

pit to underground operation. Good housekeeping, attention to maintenance and minor heat recovery projects are yet the mainstay of energy conservation in this sector.

Cement Manufacturing

1990 energy use was even with 1989 rates even though clinker production fell 6.5% to 10.5 million tonnes. Reported capacity is now 83.6%. Anything less than 100% is a drag on efficiency.

Overall, energy intensities have improved 1.2% since 1985 but a more satisfactory 24.6% since the 1974 Base Year rates. Average energy intensity is 4,969 MJ/tonne for clinker production with lower 4,724 MJ/t in dry plants and higher 6,013 MJ/t in wet plants.

While coal and coke provide 64% of the fossil energy input, cement manufacturers are trying to reduce consumption of these carbon-rich fuels to lower costs and reduce CO₂ emissions. For instance, St. Lawrence Cement Inc., Eastern Canada's largest producer, has tried for some time to get environmental approval to burn municipal wastes in its Mississauga plant as done in many U.S. and European plants. In a 1988 survey, the Portland Cement Association (PCA) found that 32 of 87 world plants use wastes such as tires, waste oil and solvents to supply 5.2% of the total energy input. Half of the Canadian plants get only 1.9% of their fuel from waste materials.

The 1988 PCA study also found there is a large difference in operating efficiencies throughout the world. Canadian cement makers are 19% more efficient than U.S. and 10% more efficient than English plants. However, Canadian plants are 27% less efficient than Japanese, 24% less than Swedish, 23% less than Swiss, 14% less than French, and 7% less than Spanish plants.

Clay Brick, Tile and Clay Products

Clay product manufacturers' performance gained a marginal 0.5% in 1990 to raise the total gain since 1977 by 26.9%. This sector also suffered from the construction slump but attention to plant productivity was successful. Brick making plants are highly automated operations with computerized controls.

The energy intensity of clay bricks averages 3,585 MJ/tonne (1.8 tonnes/1,000 equivalent units) while batch making of other clay products, i.e., tiles, sewers,

etc., is often three to four times the intensity of brick manufacture.

Concrete Products

This diverse sector has about 900 different concrete block making and redi-mix operations spread throughout the country. Product energy intensities are the lowest in the industry with block making in the 350 - 500 MJ/tonne range.

Because of the above, performance varies more than other groups. For instance, survey results show efficiency increased 3.5% in 1990 though production dropped 11.9%. When this scenario happens, it usually means the least efficient plants are shut down to keep capacity at the better plants up. Surveyed companies report that downtimes are being used to upgrade equipment and improve steam curing and boiler systems.

Glass

This survey includes only the seven largest multi-plant primary producers that use about 80% of the total energy consumed throughout the industry. Manufacturing performance increased 0.7% in 1990 to raise overall productivity 35% above 1978 Base Year operating rates. Efficiency suffered from the 8.7% decline in production that resulted from the construction slump and continued competition from the plastic container industry.

The glass industry offers some sharp contrasts in the way energy is used and how energy intensities can vary. For example, glass making is a very energy-intensive operation requiring about 4.7 GJ/tonne for the melting operation alone. Since much of the industry operates at the high value-added forming and decorative end of the business the ratio of energy cost versus sales (about 6%) is one of the lowest in the surveyed group. This survey is based on energy use per tonne produced.

Lime

Energy efficiency in this group fell 4.6% due to a 10% drop in production and corresponding drop in capacity utilization. Performance was helped somewhat by reported improvements in kiln operation, installation of high efficiency motors and electrical demand controllers.

In the past 5 years of monitoring a significant shift of the energy mix to less CO₂ polluting fuel has been made. The proportion of coal use has been

reduced from 42% to 24%. Natural gas, electricity and heavy fuel oil use have each gone up 5%. This trend has now stabilized given the relative economics of the different fuels and process technologies.

Miscellaneous Minerals

Total efficiency in this diverse group was marginally up 0.4% to raise the gain 12.8% more than 1977 operating conditions. Even though the surveyed companies produce a vastly different range of products, the production techniques used are much the same, i.e. crushing and pulverizing, milling, refinement and drying. Electricity is the dominant source of energy (57%) while 36% is provided by natural gas for product drying and heating purposes.

Electrical systems thus continue to receive the most attention. Maintenance and housekeeping were also reported as important energy management activities.

Refractories

Surveyed companies continue to report that short-run production and ever changing product mix make it difficult to track performance accurately. Energy consumption has decreased 5.8% in the responding companies but this is not tied to corresponding production changes.

Nevertheless, companies report that energy conservation is an active management pursuit. From previous reports, most have shown that technical audits have been made and economic opportunities have been acted upon.

The energy intensities of fired products are in the 6,500 MJ/tonne range and energy costs usually represent about 40% of the manufacturing expenses. About 85% of the total energy is supplied by fossil fuels, which can be either natural gas or fuel oil depending on the location of the company.

Energy Use and CO₂ Emissions

Energy conservation and substitution of less carbon-rich fuels are prime techniques for lowering emissions of greenhouse gases. Since CO₂ is the major focus of current attention, the trend of its release from the fuels and electricity used within the surveyed companies has been calculated.

Based on the fuels and electricity used in 1979 compared to 1990, for instance, the rate of emission

related to fuel substitution went up from 66.3 tonnes/GJ to 74.2 tonnes/GJ consumed. This fuel-substitution effect resulted from a shift from fuel oils to cheaper but more carbon-rich coal. Fuel oil emits* from 71.54 to 73.1 tonnes per terajoule while Canadian bituminous coal gives off 92.1 tonnes per terajoule when burned.

However, increased energy utilization during the same period had a more positive impact. Energy efficiency increased 16.8% between 1979 and 1990 and, in effect, thereby lowered the rate of CO₂ emissions. Based on the 7,520 terajoules of energy used in the surveyed companies in 1990, and assuming the efficiency increase applies equally to all fuels, the rate of emissions would have been 12.5 tonnes/TJ higher without any increased efficiency. The net emission improvement rate is therefore 4.6 tonnes/TJ. For the surveyed companies this amounts to 34.6 thousand tonnes less CO₂ dumped into the atmosphere in 1990 compared to operating conditions in 1979.

Table II displays the total consumption and trends of each type of energy used.

**Carbon dioxide emission factors, Environment Canada, Report EPS 5/AP/2, May 1990, p xvii*

Table I

Group Energy Consumptions and Performance

<u>Sector</u>	<u>1990 Consumption Terajoules</u>	<u>1990 Eff.% Gain</u>	<u>Total Eff.% Gain</u>	<u>Total 1990 Target</u>	<u>Base Year</u>
Abrasives	3,105	-2.06	12.4	20	1982
Asbestos	5,137	3.29	12.9	10	1979
Cement	52,130	0.00	24.6	40	1974
Clay Brick	3,434	-1.54	26.9	40	1978
Concrete Products	974	3.58	22.2	20	1979
Glass	21,829	-1.03	35.6	50	1974
Lime	6,492	5.00	18.1	25	1979
Miscellaneous	6,770	0.57	12.8	15	1977
Refractories	1,427			15	1978
Total	101,303	0.66	26.4	35	1977

Table II

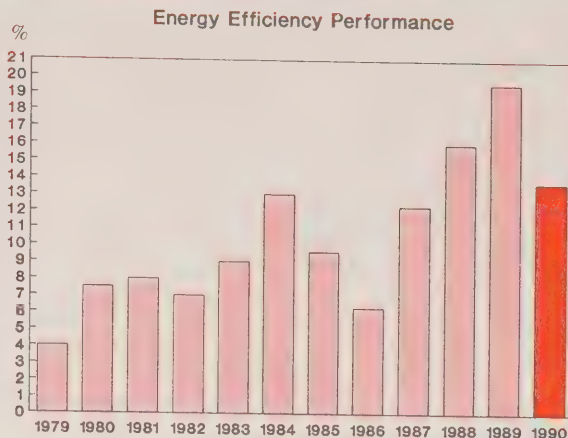
Energy Use and Efficiency

<u>Type</u>	<u>Units</u>	<u>Petajoules</u>	<u>Distribution %</u>		<u>1979</u>
			<u>1990</u>	<u>1985</u>	
Natural Gas	1,130,959,488 m3	41.174	40.6	42.6	44.9
Electricity	5,121,401 MWh	18.419	18.2	15.5	13.9
Liquid Petroleum Products:					
#2 Fuel Oil	15,883 kL	0.61	0.6	0.6	2.7
#6 Fuel Oil	110,546 kL	4.490	4.4	4.0	14.5
Diesel & Gas	60,610 kL	2.402	2.3	2.0	7.4
Coal	991,900 T	31.840	31.4	34.0	15.8
Other Fuels:					
Propane, Naptha, LPG	17,367 kL	0.458	0.4	0.2	0.2
Steam		1.903	1.8	1.0	0.6
Total 1990		101.303			

Mining & Metallurgy Industry

Energy Conservation Task Force

Paul B. Batten
Chairman



Introduction

The companies in this survey produce several basic metals, minerals, by-product fertilizers, and synthetic oil. The principal metals processed include: gold, copper, nickel, lead, zinc, silver, iron, and molybdenum.

This survey covers 85% of the integrated metal mining operations as well as one major tarsands synthetic oil producer and a large potash mining operation. All 19 surveyed companies, with 46 different operating sites, are members of the Mining Association of Canada (MAC). At last count there were 123 integrated mining companies operating throughout Canada.

Performance

Combined efficiency declined 5.8% in 1990 even though many individual results were positive. Industry performance has also varied since monitoring began in 1977. Performance has advanced 7 times and receded 6 times. Performance in this resource-based industry is clearly very sensitive to domestic and international business conditions. For example, world commodity pricing affects selling prices and profit margins which influence investment patterns more than most other manufacturing industries.

The overall efficiency improvement, however, is 4.1% better than 1985 reference values and 13.7% more efficient than the 1973 Base Year operating conditions. The lower 1990 performance thus caused the total gain to slip below the 5 year term improvement goal of 15%.

In spite of the reduced 1990 performance efficiency, the annualized cost saving still amounts to

\$8.4 million per year. This is based on an estimated total cost of \$1.02 billion for electricity and fuel and the overall rate of improvement since 1985. The average cost of energy throughout the industry was about \$4.76 per gigajoule. Costs can vary by +/- 15% depending on availability of direct-purchase natural gas.

Energy costs often amount to about 5% of the value of shipments in integrated mining operations according to recent Statistics Canada (cat.#26-223) data. This percentage is steadily climbing because energy prices are escalating faster than product selling prices. In small remote sites, studies have shown that energy costs often add up to 30% of production expenses.

Factors that Affected 1990 Performance

The severe 1989-1990 recession is the major cause of reduced production volumes, lower capacity use and energy efficiency. As well, several companies experienced unusual production outages for inventory control or prolonged labour negotiations.

Productive capacity fell from 92% to 86% in the larger surveyed companies during 1990. The industry wide average, according to the StatsCan method of calculation, declined from 86% to 85% in 1990. Some gold mining companies reported operating at 50% capacity.

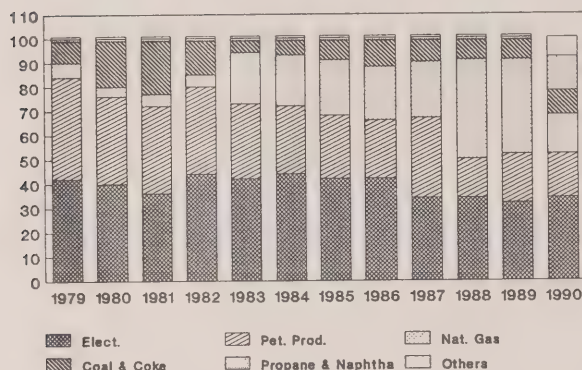
The dominant gold mining sector was hit especially hard with shutdowns of many marginal operations. Throughout 21 of the major companies in 1990, the extent of asset writeoffs amounted to \$1.4 billion with \$1 billion of this in the gold mining sector alone.

Paradoxically, these shutdowns would have had a helpful impact on overall performance, but these effects cannot be measured. Several companies reported future shutdowns will be necessary to offset the losses caused by low metal prices.

Low profit margins also curtailed investments normally made to upgrade and improve existing

Figure 2

Energy Shares (%)



operations. After reaching peak levels of income in 1988, industry-wide spending on new facilities declined from \$2.1 billion to \$1.5 billion in 1990. Non-capital spending on maintenance was stable at \$1.2 billion. Energy efficiency is often helped significantly by minor improvements and housekeeping actions. The most rapid decline (57%) in total capital spending, however, occurred in the gold mining sector.

Now there is a growing environmental concern that has started several energy-intensive waste-recovery projects throughout the industry. Most of these new installations also compete for scarce investment dollars. For example, INCO reported that \$155 million of its 1990 \$500 million capital budget will be spent on a new sulphur abatement project at its Sudbury site. This energy-intensive project is expected to hamper site energy efficiency for 3 years. Similarly, Hudson Bay Mining and Smelting Co. Ltd. is also planning a major waste recovery project at its Flin Flon smelter.

Meanwhile, housekeeping type activities such as combustion improvements and steam use reductions

continue to be the backbone of energy conservation efforts. One multi megawatt cogeneration project is also under investigation but will take at least 2 years to install.

Energy Use Trends

The surveyed energy consumption shown in Table II amounts to 143,357 terajoules, which is equivalent to 3.72 million m³ (23.4 million barrels) of crude oil. This survey therefore represents about 85% of all integrated and related mining operations. The survey does not include asbestos mining, oil wells and quarries that are normally grouped in the same Standard Industry Classification (SIC) "06" classification.

Past shifts in energy shares have occurred more because of changes in the reporting population than due to fuel substitutions. Early surveys contained a greater number of coal mines and locations not having access to cheap natural gas. In the past three years, Syncrude's higher percentage of off-gas fuels have also had a major impact on the total share picture, as shown in Figure 2.

Future substitution trends will probably show the effects of large-scale cogeneration projects as well as possible limitations on emissions of greenhouse gases.

Energy Use And The Environment

With increasing concern about the emission of greenhouse gases into the environment, a preliminary analysis of CO₂ effluents was made. This was done to determine the overall effects of fuel substitutions and reported efficiency improvements.

The various methods of generating electricity in each province, i.e., from polluting fuels such as coal as well as non-polluting hydraulic sources were taken into account. Representative CO₂ emission factors were also applied to the surveyed fuel consumptions.

The results indicate that 7.4 million tonnes of CO₂ were discharged into the atmosphere from the fuel and electricity used by the surveyed companies in 1990. Based on a realigned reporting population, CO₂ emissions were reduced 17% (1.2 million tonnes) between 1980 and 1990. More than half the reduction (10%) was due to fuel substitutions while less than half (7%) was due to the reported efficiency increases.

It is unlikely that similar future environmental improvement gains will be available from these two

energy management sources. A reduced rate of fuel substitution and slower efficiency increases should be expected given the current forecast of business conditions. There will probably be more electricity used in mining operations but the emissions differ from the various methods of generation.

Looking to the future, companies were asked to consider and rank several possible government initiatives (Table I) that could impact on energy efficiency and consequently on CO₂ emissions. These were ranked as: 5 = strongly in favour to 1 = strongly against. Some of these initiatives have already been mentioned in the Federal government's new Green Plan. Others may be contained in the upcoming National Energy Efficiency Act.

Table I

Increased technical transfer activities

Technical Seminars	4.6
News Publications	4.3
Energy Monitoring Software	4.1
Regional Training Centres	3.7
Consulting Assistance, surveys	3.5
Electronic Bulletin Boards	3.4

Financial Assistance

Accelerated Tax Incentives	3.9
Special Grants	3.6
Low Interest Rate Loans	3.6

Possible Legislation

Emissions Credit and Trading Programme	2.9
Mandatory Energy Efficiency Monitoring	2.9
Effluent Charges	2.9
Mandatory Performance Inspections	2.7
Energy Price Intervention	2.0

In general, while most (3.8) favour the 'Polluter Pays Principle', the responders felt that increased technical transfer activities (4.3) would provide the broadest and most useful benefits. Some form of financial aid is considered helpful while additional government intervention is unwanted.

Table II

Energy Efficiency Improvement

Current Year Energy Consumption	143,357 Terajoules
Base Year (1985) Equivalent Energy	148,309 Terajoules
Adjustments	1,190 Terajoules
Net Improvement (1985-1990)	4.1%
Annual Changes 1973-1985	9.6%
1986	-3.3%
1987	6.0%
1988	3.7%
1989	3.6%
1990	-5.9%
Total	13.7%

Table III

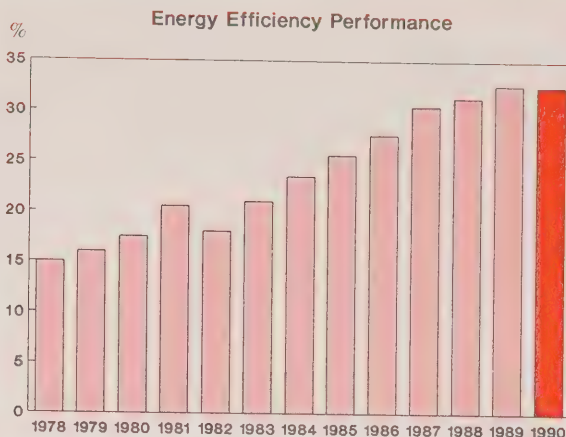
Energy Consumption & Carbon Dioxide Emissions

Type	Quantity	Terajoules	Percent	CO ₂ emissions	
				Tonnes	Percent
Natural Gas	624,193,992 m ³	23,220	16.2	1,153,570	15.5
Electricity	13,570,627 MWh	48,854	34.1	1,967,029	26.5
Petroleum Products:					
Distillate Oil	27,564,355 litres	1,075	0.8	78,593	1.1
Residual Oil	306,808,459 litres	12,676	8.8	906,841	12.2
Diesel	27,564,355 litres	11,594	8.1	819,580	11.0
Gasoline	15,088,692 litre	546	0.4	37,117	0.5
Coal	247,788 tonnes	7,954	5.5	732,563	9.9
Coke	245,021 tonnes	5,709	4.0	539,044	7.3
LPGs	750,587,174 litres	19,968	13.9	1,194,885	16.1
Others (steam, water)	n/a	<u>11,756</u>	<u>8.2</u>	<u>n/a</u>	
Totals		143,352	100.0	429,223	100.0

Petroleum Refining Industry

Energy Conservation Task Force

Kerry A. Mattila
Chairman



Introduction

This report is based on submissions from seven companies which process about 85% of the crude oil upgraded and refined in Canada.

Major operating changes in the industry since 1972 have made it necessary to adopt a more recent base year to accurately quantify progress in energy efficiency. As a result, 1985 is now used as the common reference year. For statistical continuity, annual changes in performance since 1985 have been added to the 25.6% gain previously reported.

Energy Efficiency Improvement

In 1990, the petroleum refining industry experienced a marginal loss of energy efficiency by dropping 0.1% during the year. The net gain from 1985 is 6.86% while the overall improvement is 32.5% better than comparable 1972 base year operating conditions.

The minor decline resulted from the combined effects of refinery revisions to compensate for tetraethyllead phase-out and lower throughputs caused by the economic recession. Without any processing adjustments to equate to 1985 operating conditions, the gain would have been 9.5%. The 30% improvement target that was set 5 years ago was surpassed in 1988.

Almost all of the major energy conservation projects arising from process studies conducted through the 1980s have been completed. Few new major capital projects are planned for implementation in the near future. Recent instability of crude oil and product prices resulting from the Gulf war are continuing to complicate investment decisions regarding energy conservation and other projects.

Falling product demand has also put a further strain on investment capital for energy efficiency projects. No significant new investment is anticipated until the market for petroleum products recovers.

However, any additional processing equipment needed to meet new government processing or environmental regulations will be designed with the highest possible energy efficiencies. It is anticipated that many of these projects will consume additional fuels and electricity and take a significant amount of the available funding normally spent on efficiency related projects.

Operations and Maintenance

Previous CIPEC reports have described numerous energy conservation improvements. Despite the instability experienced by the petroleum refining industry in 1990, energy managers have nevertheless concentrated on the following activities:

- Closer analysis and attention to process settings;
- Increased direct responsibility for achieving conservation goals assigned to operators and maintenance workers;
- Emphasis on training of operators and technical staff;
- Continued commitment to timely repair of steam leaks, damaged insulation, steam traps, etc., and to heat exchanger cleaning;
- Optimization of steam systems;
- Improvements in energy monitoring and control techniques;
- Application of process optimization techniques.

Capital Projects

Less capital investment in energy efficiency occurred in 1990 than previous years. However, the main emphasis of investment was on improvement of process control systems and steam reduction.

Technology Improvements

Recent gains in energy efficiency have come partly through application of the latest advances in processing technology. Now, the industry has a strong interest in certain R&D improvements being developed throughout the world. The most promising of these developments include:

- Improved catalysts and additives;
- Techniques to reduce crude oil and product losses;
- New equipment designs to increase heat recovery;
- New techniques to convert gas components into process liquids;
- Advanced computer control and process optimization techniques;
- Sophisticated data acquisition and management systems;
- Applications for high efficiency electric motors and drives;
- Advanced equipment for monitoring and control of electrical power;
- New types of on-line liquid and gas stream analyzers;
- Flare gas measurement and recovery techniques.

Task Force Activities

When the Petroleum Refining Industry Task Force was first established in April 1977 it consisted of separate Steering and Technical Committees to handle the policy and technical related work. The independent Petroleum Association for Conservation of the Canadian Environment (PACE) organization was used to consolidate and maintain the confidentiality of the industry's operating data.

These functions have now combined within the Canadian Petroleum Products Institute (CPPI) and are administered at its own expense.

Future Outlook

The flat performance experienced in 1990 is unlikely to improve in 1991 as forecast reductions in product demand will have a continuing impact. Efficiency should rebound when the economy emerges from the recession, but a full recovery is not expected until early 1992.

Continuing instability in product markets and corresponding losses in profitability will make investment capital extremely scarce. As well, continuing changes to product specifications, such as the expected introduction of low-sulphur diesel fuel, will require new processing facilities. While these will be designed to include all practical efficiencies, overall energy consumption per unit of output is expected to increase. It is therefore very difficult to foresee a return to the 1989 peak efficiency for some time.

Table I

Performance Calculations

Current Year Total Energy Input	318.6 petajoules
Equivalent Base Year (1985) Energy	313.9 petajoules
Adjustments (See Table II)	26.2 petajoules
Gross Improvement (1985 - 1990)	9.46%
Net Improvement (1985 - 1990)	6.86%
Net Changes 1972 -1985	25.6%
1986	2.0%
1987	2.9%
1988	0.8%
1989	1.3%
1990	-0.1%
Total	32.5%

Table II

Processing Adjustments

Total measured energy consumption rate	3691.3
Processing Adjustment*	114.4
Lead phase-out and higher Mogas Octane	27.4
Increased desulphurization	1.0
Product mix changes	-0.7
Other processing adjustments	104.3
Major capacity additions	-30.7
Reprocessing of wastes	N/A
Throughput Effect	-6.5
Miscellaneous	94.7
Total Adjustments (line 2-10)	304.0
Current Operations Adjusted to B.Y. conditions	3387.4
Base Year (1985) Actual Energy Consumption	3636.1
Energy conserved (line 13 minus 12)	248.7
Percent change from Base Year (1985)	6.86
Total Refinery Input (1985)	198,100 m ³ /day
Total Refinery Input (1990)	236,500 m ³ /day

* Calculated on Nelson Complexity
Index of 498 MJ/m³ of throughput.

Table III

Consolidated Energy Use

Type	Units	Quantity	Energy (PJ)	Percent
Natural Gas	m ³	1,186,020	45.55	14.3
Electricity	MWh	4,478,433	47.47	14.9
Residual Oil	m ³	588,00	6 24.53	7.7
Petroleum Coke	kg	1,718,966	60.21	18.9
Other Fuels				
LPG	m ³	83,792	2.23	0.7
Refinery Gas	m ³	3,696,81	45.55	42.8
Steam	kg	1,027,373	2.86	0.9
Total			318.6	

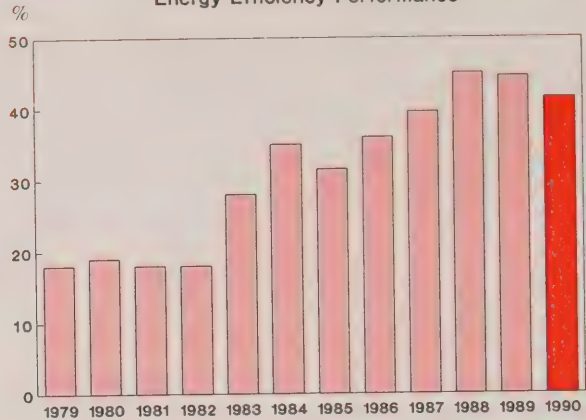
* Purchased electricity converted at gross 10.551 MJ/KWh rate.

Plastics Processing Industry

Energy Conservation Task Force

Chris LeClair
Chairman

Energy Efficiency Performance



Introduction

This survey covers 41% of the independent processors that make up about half of the \$11 billion total plastics business in Canada. These results come from a variety of companies that use all manner of processing technologies. These include: extrusion, injection moulding, thermoforming, foam and blow moulding, and film making operations.

The survey does not include large resin makers, specialized compounders, distribution companies, equipment makers, or those processors that are an integral part of other manufacturing industries such as automotive and electrical.

Energy costs in the surveyed companies range from \$2.7 million down to \$30,000. Eighty percent of the firms had energy costs above \$200,000.

Energy Performance

The general business recession that started last year had a large impact on this year's energy utilization. After performance slipped 0.4% in 1989, a further decline of 2.9% occurred in 1990 as a result of a 6.6% drop in production which resulted in an 8% decline in capacity utilization. Several companies in the survey reported capacity usage down by 20% or more. The peak energy utilization occurred in 1988 as a result of capacity rates reaching 100% in late 1987 and carrying through 1988.

The overall gain of 41% consequently fell short of the 1990 goal of 50% because of this year's negative results.

Energy utilization has gone through three distinct phases in the plastics processing sector since

monitoring began in 1979. The first four years of performance was relatively flat because energy conservation efforts were just getting started when the impact of the 1981-82 recession gave pause to the majority of improvements.

In the second phase between 1982 and 1988, the rapid annual performance increase of 4.6% per year was due to booming increases in production volumes, rising capacity rates and a steady investment in new machinery. Most all processors shared in this phenomenal growth. At the end of this growth period management then found it necessary to rapidly shift its focus more to productivity issues because of rising international competition.

In some cases companies were merged to strengthen their financial and technical capabilities. Businesses were often streamlined to optimize production on selected products which required specialized equipment. Sophisticated new computerized controls were added. Mold changing techniques were steadily improved to shorten time lost between production runs. Extrusion flow problems were the focus of attention and helped with new mold designs and experimentation with new gas injection techniques.

However, even though most of the equipment makers were offering high efficiency motors and other enhanced energy conservation features such as dual extrusion screws, variable speed hydraulic pumps, etc., processors were somewhat reluctant to use these new features because of the additional capital expense and specialized personnel training involved for operation and maintenance.

But the plastics processing industry is a good example of the close technological cooperation existing

between equipment makers and end-users. Equipment suppliers are now working more closely with their customers by offering special training courses to teach operators how to get the most out of the newest equipment. As well, equipment makers are simplifying their controls to make complex machines easier to operate.

For example, programmable controls have been trimmed down to the bare essentials with visible menu screens made more user friendly. Artificial Intelligence (AI) systems now exist that automatically adjust operating conditions during each machine cycle to minimize production losses and scrap.

Even with all these improvements, however, Canadian companies are still slower than European and Japanese firms to introduce the newest enhancements because of the less favourable Canadian tax structure and higher borrowing cost of capital.

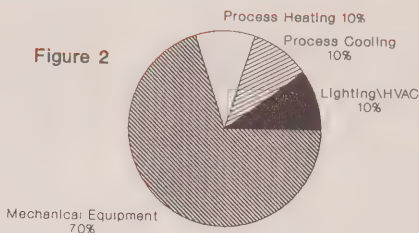
It is unlikely that future performance increases will return to the high rates seen between 1982 and 1988. Slower rates of production growth are forecast because of the sooner-than-expected competition from international companies, the shift of some industrial customers to the U.S. and Mexico, and the slow down in the rate of substitution of plastics for other traditional materials.

New environmental restrictions on final disposal of plastics may also effect future production rates. The Canadian Plastics Institute and Ontario Hydro have therefore decided to conduct a major study into the current state of the industry's equipment, technology penetration, viable opportunities and common barriers to future conservation. Even though three-quarters of the industry is located in Ontario, the study is expected to benefit all processors in the other provinces.

Energy Use Patterns

The combined share of electricity has risen from 40% in 1979 to 44% in 1990. This is due generally to a larger concentration of the industry in Ontario where larger plants can be run more continuously. Special incentives offered by Hydro Quebec have resulted in some plants using only electricity.

Figure 2 shows the general results of a survey by Ontario Hydro of where electricity is used in the plastics industry.



Energy use in the various processing operations is significantly different, however, because of the nature of the processes and the equipment used. For example, electricity often provides between 80% to 90% of the total energy in extrusion and injection molding operations. This amount varies somewhat depending on the machine clamping capacities, resins extruded, continuity of production schedules and the size of resin heaters used to compensate for the different extrusion pressures.

Custom shops often see electricity shares from 20% to 70% because of the greater amount of machine idle time and supplemental factory heating and ventilation.

The share of electricity use in film making can also be as high as 90% because of the elaborate resin heating systems and film cooling equipment. Much of the recovered heat from the process is used to heat the factories, which lessens the need for fossil fuels. Electrical energy intensities for film making (about 14 GJ/kg) are sometimes twice that of the less intensive blow molding and plastics coating processes.

The electricity share in the plastics coating and thermoforming processes are in the 25% to 30% range. In this case it is used primarily for motors on materials handling equipment and for other plant utilities.

Most plastics processing operations are exothermic, which require extensive cooling towers to exhaust the unusable surplus heat. Numerous studies exist on how best to recover rejected heat. The film making process appears to offer the best potential because of recent improvements in heat pump technology.

Table I

Energy Consumption and Trends

<u>Type</u>	<u>Units</u>	<u>Terajoules</u>	<u>Percentage</u>		
			<u>1990</u>	<u>1985</u>	<u>1979</u>
Electricity	381,729 MWhr	1,374.2	43.6	43.2	40.0
Natural Gas	46,138,311 m ³	1,716.3	54.4	47.2	55.5
Propane	396,691 Litres	10.5	0.3	0.2	0.6
Liquid Petroleum Products:					
Distillate Oil	763,874 litres	29.8	0.9	1.1	1.0
Residual Oil	68,173 litres	2.7	0.1	1.6	3.5
Diesel	350,307 litres	13.9	0.4	0.3	0.1
Gasoline	130,558 litres	4.7	0.2	0.3	0.1
Total		<u>3,152.7</u>			

Table II

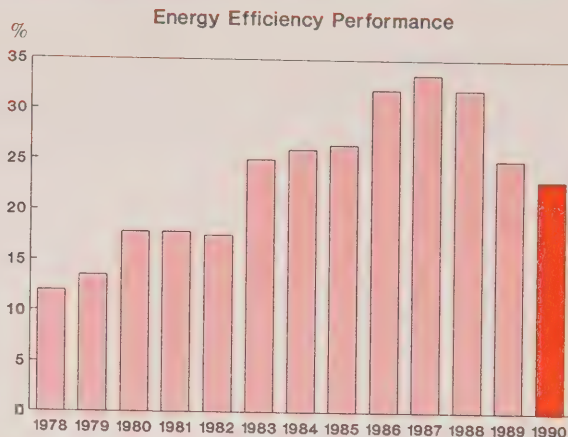
Energy Use and Efficiency

Current Year Total Energy Inputs:	3,152.7 Terajoules
Base year (1985) equivalent energy:	3,439.7 Terajoules
Efficiency Improvement 1980 to 1985 =	31.48 %
1986 =	4.35 %
1987 =	3.63 %
1988 =	5.49 %
1989 =	-0.41 %
1990 =	<u>-2.94 %</u>
Total	41.60 %

Pulp and Paper Industry

Energy Conservation Task Force

M.J. Frost
Chairman



Sector Description

The Canadian Pulp and Paper Association's Energy Monitoring Report covers 61 companies that operate 121 mills, accounting for about 95% of the total pulp, paper and paperboard produced in Canada in 1990. Five of the mills included in the report are not members of the association. A list of participating companies is appended.

Performance

Purchased energy per ton of product increased slightly during the year with the result that reduction in purchased energy since 1972 now represents 23.6% versus the industry's objective of a 33% reduction for the 1990 year.

The major source of purchased energy continues to be electricity which accounts for 36.8% of the total purchased energy. Heavy fuel oil is 27% of the total, which is 42% of the amount used on an equivalent production basis in 1972. Natural gas has increased to 31.8% of the total purchased energy.

The reduction in heavy fuel oil use is equivalent to 3.22 billion litres. The total purchased energy use is equivalent to 2.65 billion litres of heavy fuel oil when compared to the base year of 1972.

Operating Conditions

Shipments of pulp and paperboard for the year 1990 declined by 2.9% compared with 1989. Overall, the industry operated at 87% of capacity for the year.

Replacement of fossil fuels with wood wastes generated by the industry and neighbouring wood

products operations declined slightly during the past year. These wood wastes now account for 63% of the total fuels consumed throughout the industry. Waste fuels plus captive hydraulic power now account for 52% of the energy used, up from 42% in 1972.

Technological Developments

The east angus Quebec mill of Cascades (East Angus) Inc. was awarded CPPA's Technical Section Energy Conservation Opportunity Award in 1990 for conversion to a biomass suspended firing system. To replace a large idle electric boiler, the company converted an old oil-fired boiler to use dried pulverized wood.

The total energy savings (oil versus wood), less system operation and maintenance costs, are estimated at \$11.8 million per year. The cost of conversion was \$5.6 million including modifications to the woodroom.

The B&W (Stirling) 100,000 lbs/hr was originally designed to fire pulverized coal in 1953. It was determined that suspension firing in this boiler could be successful. The new fuel source is sawmill waste dried to less than 10% moisture and pulverized to 1/16 inches for pneumatic conveying into the two suspension burners. These burners can now use three different fuels (oil/wood/gas). By using flue gas to dry the hog fuel the mill uses approximately 30% less fuel compared to undried fuels. No major modification was necessary on the boiler itself.

PAPRICAN's applied research program continues to include many projects that have significant energy conservation potential. Many of these projects develop new basic technological concepts that help improve energy management. Some examples of such projects are listed below:

Groundwood Control

New control systems are being developed for groundwood mills that allow production of pulps with improved quality while at the same time reducing energy input.

Status: Mill Trials.

Mechanical Pulping Control

Improved process control in mechanical pulping can also reduce both energy consumption and fluctuations in pulp quality. These techniques require sophisticated on-line measurement and control of consistency of chip and pulp production.

Status: Mill Trials

Energy and Refining Intensity Split

Thermomechanical pulp is usually produced with two refiners operating in series. There is experimental evidence that shows specific energy can be reduced and pulp quality improved through optimization of the two stages. Refining intensity depends on:

- a) rotational speed
- b) type of refiner
- c) refining consistency
- d) plate pattern

Status: Tested in pilot plant.

Interstage Peroxide Brightening in TMP Systems

Treating thermomechanical pulp with caustic and hydrogen peroxide after the first stage of refining brightens pulp and softens the fibres and fibre bundles. This fibre softening makes possible:

- a 20-40% reduction in energy input with the same pulp strength and production rate.
- a 20-40% increase in production with the same pulp strength and energy input.
- or any combination of the above effects.

It also uncouples the operation of the second stage refiners from the first stage to allow better distribution of the energy between the two stages.

Washing pulp at the interstage process gives a lower volume of concentrated effluent that requires less equipment investment than required for combined mill and paper machine effluents. Anaerobic treatment is particularly attractive for this concentrated stream.

Status: Mill trial, pilot plant.

Impulse Drying

Improved water removal rates in single felted presses can be obtained by simultaneous application of high temperatures and mechanical pressure on the web at the hot metal rolls. The higher solids content after impulse drying also saves steam heat in subsequent drying operations. Impulse drying appears at this time to be applicable mainly to lighter paper grades (basis weight under 75 g/m²). Delamination problems encountered with heavier grades being eliminated.

Status: Pilot plant.

Table I

Energy Efficiency Improvement

Current Year (1990) Total Energy Inputs	349.92 petajoules
Base Year (1972) Equivalent Energy Inputs	457.84 petajoules
Net Improvement(1972 - 1990)	23.6%

Adjustments - None

Actual Base Year Consumption	352.62 petajoules
Current Year Production	24,718,975 tonnes
Base Year (1972) Production	19,037,824 tonnes

Table II

Energy Use and Trends

Type	1972* petajoules	Percent of Total	1989** petajoules	Percent of Total	1990** petajoules	Percent of Total
Coal	15.64	3.4	4.11	1.2	4.58	1.3
Petroleum Products						
Residual Oil	225.33	49.2	105.91	30.1	94.59	27.0
Distillates	7.99	1.8	4.83	1.4	4.08	1.2
Natural Gas	92.22	20.2	103.96	29.5	111.34	31.8
L.P.G.	1.01	0.2	0.81	0.2	1.04	0.3
Other	4.76	1.0	3.27	0.9	5.46	1.6
Electricity	110.89	24.2	129.42***	36.7	128.85****	36.8
	457.84	100.0	352.31	100.0	349.92	100.0

*Base Year volume equivalents.

**Actual use

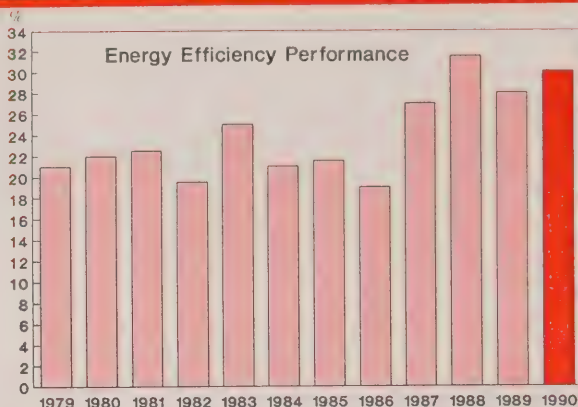
***3.18 petajoules (2.5%) used in electric boilers.

****1.89 petajoules (1.5%) used in electric boilers.

Textile Industry

Energy Management Task Force

J. Guy Morin
Chairman



Introduction

The textile industry in Canada is complex and diverse. It is an industry that is as old as man and modern enough to produce space-age materials.

The textile industry includes producers of man-made fibres; producers of yarns and fabrics; producers of consumer and industrial textiles; plus firms that dye and finish textile yarns and fabrics.

Its products are used in agriculture, apparel, construction, defence, the production of many industrial goods, environmental protection, transportation, packaging and health care.

The Energy Management Task Force of the Canadian Textiles Institute represents companies accounting for more than 90% of textile production in Canada.

The textile industry is technologically innovative and larger than it has ever been. It has survived and prospered due to a high rate of capital investment and the increasing emphasis that is being placed on training.

Historically, recessions have a more severe impact on textile manufacturing than other sectors. This has been true for the 1989-1990 recession although, on average, the impact on textiles has not been as severe as in 1982.

Despite a high Canadian dollar and a recession, textile exports to the United States increased by 29% in 1990 or by \$129 million. Textile exports to all countries rose by 18% to just under \$1 billion.

Textile industry shipments in 1990 were \$6.2 billion making last year the fourth largest in the industry's history. The all-time record was set in 1988, when shipments reached \$6.7 billion.

Total Canadian textile investments in 1990 were \$515 million, which sets a new annual record. Investments during the 1980s exceed \$3.6 billion. Investment intentions for 1991 are down slightly, but if the forecast is met, 1991 will be the second largest investment year in the industry's history.

1990 Performance

With a net energy efficiency improvement of 1.5% in 1990, the textile industry came within 1.2% of reaching the 1990 target of a energy efficiency gain of 31%.

Since 1974, this makes for an overall gain of 29.8%.

Textile energy improvement in 1990 results from the record levels of capital investment in the industry. Textile efficiency largely depends on capacity utilization and any gain during a recession marks a major step forward.

Task Force Activities

A number of factors limited Task Force activities in 1990. These included uncertainty over CIPEC's budget and future focus; the need for managers to devote their attention to surviving the recession; and the availability of relatively stable and cheap energy supplies.

Within this context, Task Force activities have been limited to gathering energy data and to analyzing how best to reorganize textile energy activities.

Much thought has been given to improving textile energy efficiency in the coming years. Textile mills use large amounts of energy to produce material. This energy is usually provided by steam which originates at a central boiler. The Task Force is considering

placing the emphasis on how to reduce the size of these boiler systems through the use of new technology based on dedicated application energy sources.

The following case history is an example of this technology in action.

Case History

Traditionally, energy efficiency gains have been achieved by decreases in the amount of energy that it takes to produce a kilo of product. Another way of achieving energy efficiency gains is through increased productivity. In the following case history, the same amount of energy used before the installation of new equipment is able to produce increased volume.

This case history also represents what may be believed to be the best way to produce energy gains for the future, the removal of specific operations from a central boiler and firing or heating of these operations through dedicated power sources.

Boiler system decentralization provides greatly reduced steam losses. Reducing the capacity of steam plants, in some cases, may also reduce the need for supervisory personnel.

In this case, a carpet company wanted to increase its dryer productivity by 15% and solve humidity problems created by poor air distribution. The dryer was heated by steam coils connected to a central steam system.

After an extensive analysis which included comparing the merits of both infrared and direct fired technologies, the company chose three direct-fired gas model 400 Ovenpak, Maxon burners to replace the steam coils.

Including installation, the cost came to \$85,000. The work took less than ten days. There were no production losses because the work was performed during vacation. The capital investment was recovered through greater productivity in eight months.

While not all of the humidity problems were solved, the increased productivity target of 15% was exceeded. On lighter materials increased productivity has reached 40%. On heavier materials the increase was 20%. The average increase was 25%.

This example also illustrates the growing tendency to lock energy gains into improved quality and productivity.

Energy Use Patterns

There were virtually no changes in energy use patterns in the textile industry during 1990. While minor changes in the use of some energy forms did occur, the changes accounted for less than 2% of each category. These changes are too small to form the basis of any predictions or to warrant detailed explanation. They can best be described as resulting from the random installation of new or replacement machinery necessitating energy source changes.

Future Outlook and Concerns

The traditional image of textile manufacturing as a declining sector no longer reflects reality. New records in shipments, investments, and exports are characteristic of a dynamic industry.

Textile manufacturing has become a major user of high technology, a provider of fewer but higher quality jobs, with rapidly growing productivity, and better than average profitability.

The industry has committed itself to innovation, change and long term participation in the evolving global trade and economic environment. Its objective is to continue to improve its international competitiveness and already substantial contribution to Canada's economic, technological, social and environmental well-being. It plans to do this in active partnership with its employees, customers, suppliers and government.

Its goal is to compete in the Canada-US free trade area from a Canadian base.

The key to its future success is continued and increased investment in technology and human resources.

Effective energy management will continue to occupy an important place in future developments. Every cost saving improves competitiveness; more efficient use of energy is a mark of good corporate citizenship; and as the Gulf War reminded us, complacency about security of future supply is unwise.

The Textile Energy Management Task Force and its activities remain an important priority for the industry.

Table I

Energy Efficiency Improvement

Current year (1990) total energy inputs	6,875,794 gigajoules
New base year(1985) equivalent energy inputs	6,980,690 gigajoules

Net Improvement over base year= 1.5%

Adjustments = None

Total efficiency gain from 1974 to 1990 = 29.8%

Table II

Energy Use**1990**

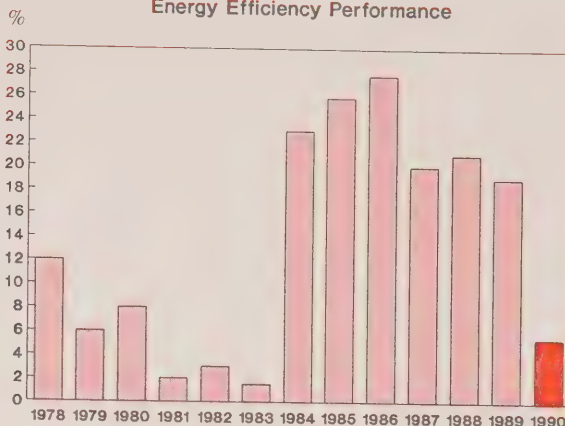
<u>Type</u>	<u>Units</u>	<u>Gigajoules</u>	<u>Percentage of Total Consumed</u>	
			<u>1990</u>	<u>1889</u>
Natural Gas	104,021,000 m ³	3,869,581	56.3	57.6
Electricity	562,952 MWh	2,026,628	29.5	28.1
Liquid Petroleum Products				
Residual Oil	21,353 kilolitres	903,232	13.1	11.8
Distillate Oil	142 kilolitres	5,538	0.1	0.1
Diesel & Gasoline	226 kilolitres	8,611	0.1	1.8
LPG	2,338 m ³	62,204	0.9	0.6
Total 1990		6,875,794	100	100

Transportation Industry

(MANUFACTURING)

Ken Rossi
Chairman

Energy Efficiency Performance



Introduction

The Transportation Industry (Manufacturing) Task Force draws its membership from the following six trade associations:

- Aerospace Industries Association of Canada (AIAC)
- Allied Boating Association of Canada (ABAC)
- Automotive Parts Manufacturers' Association (APMA)
- Canadian Marine Industries Association (CMIA)
- Canadian Truck and Trailer Manufacturers' Association (CTTMA)
- Motor Vehicle Manufacturers' Association (MVMA)

Of the 571 total companies, 63 reported their individual consumption and performance results in 1990. About 75% of the total industry's energy use is represented in this report.

The 1990 survey trends reflect the performance in a very diverse group of large and small companies. About 71% of the reported consumption was used by the 3 large MVMA companies, 17% by the 32 APMA companies, and 12% by 28 diversified members of the AIAC, ABAC, CMIA, and CTTMA sectors.

Response to this year's survey was noticeably reduced because of the effects of the general business recession and changing composition of the industry. There have been many plant closures as a result of

companies moving operations back to the U.S. or to Mexico. Survey response has shrunk back to 1988 levels as a result of 24 fewer companies reporting in 1990. APMA and AIAC participation is down by 12 and 5 respectively, and fewer by 7 in the other sectors. The reduced level of participation has also shifted the percentages of energy used in the dominant APMA sector.

Performance

Combined performance in 1990 declined by 2.6% which continued the downward trend experienced since the peak years in 1985-86. Energy consumption per unit of production is 16.8% less than it was 5 years ago.

Monitoring energy utilization in the transportation manufacturing industry is very difficult because of the unusual complexity of identifying "units of production". In the early days of monitoring, dollar value-of-shipments were used. But that system proved unworkable because of undue problems with conversion factors and timing of access to Statistics Canada's industry data. Today, units of production are counted as: automobile, engines, tonnes of iron poured, etc. Even so, an automobile, for example, is not the same as it was in 1985 nor in the early 1970s when monitoring began. Performances must therefore be measured relative to each previous years' and combined only for trend analysis.

Results displayed in the above graph, however, show that energy utilization is directly affected by

changes in production volumes, which have declined more rapidly since 1985 than before the 1982-83 recession.

Because of low product demand, only two-thirds of the output capacity was being used in 1990. Output was a full 12% below 1989's and 22% lower than 1985 peak rates. Results were aggravated by the negative trends in the dominant MVMA and APMA sectors where several of the large companies were operating at only 30% to 40% of 1985 production rates. These two sectors account for 88% of the total energy consumption and impact on performance.

In spite of these negative results, however, energy conservation will remain an important factor in company productivity improvement campaigns because of the need to control manufacturing costs.

Sector Performances

ABAC (Boating) and CTMA (Truck/trailer)

Energy use by the companies in these two industry associations represents about 1% of the total surveyed. Performance, although negative, does not have a noticeable impact on the task force total results.

Nonetheless, participation of these two associations continues to be important since it provides a broader perspective on the industry's operating conditions and concerns.

AIAC (Aerospace)

The 22 reporting companies in this sector show overall efficiency 6.5% better than the 1985 reference values.

Higher levels of performance have been reported in the past but some reductions have resulted from major environmental retrofits. These were required to improve plant safety and health standards.

This sector's performance history is also different from the other sectors' because its production volumes are geared more to special market demands. Long-term contracts also help cushion the sharp fluctuations felt by other equipment manufacturing sectors.

APMA (Auto Parts)

In spite of consistent gains in previous years, performance turned sharply downward in 1990 with a negative 26% amount. The cause is thought to be due

more to changes in the reporting base rather than reductions in companies' performances.

This sector continues to be challenged with fierce competition from offshore and Mexican operations and has noticeably suffered from many closures and relocations.

In spite of the tough economic times, many of the surveyed companies are planning new conservation measures to help improve productivity and competitiveness.

CMIA (Shipbuilding)

Energy consumption in the 4 reporting companies fluctuates widely from year to year because of the unsteady production volumes and an uncertain future business. However, energy use per unit of output is now 29% above 1985 standards.

MVMA (Motor Vehicles)

Energy efficiency dropped to a negative 16.8% position relative to 1985 reference year.

Lower capacity utilization is the major factor producing this disappointing trend. Some large companies are operating at 35% of 1985's production levels.

Nonetheless, conservation actions continued to be implemented in 1990 even though severe restrictions had been placed on capital and maintenance budgets.

The experimental solar-wall retrofit installed at the Ford Motor Company of Canada Ltd., Oakville site is proving to be a valuable installation and is spawning many installations in automotive and aircraft facilities. The accompanying monitoring system installed on this retrofit under a joint Federal/Provincial initiative is also providing valuable design information on similar solar applications.

Energy Use Patterns

Even though the reporting base has changed substantially, the electricity share is rising because of continued factory automation. As shown in Table I the electricity share has climbed at a rate of 2.6% per year up to the 33% level. However, this situation is being monitored carefully because of the rapidly es-

calating costs and potential for shortages in the near future.

Natural gas is by far the dominant fuel because of its lower cost and cleanliness of use. The small quantities of fuel oil used are required to satisfy interruptible natural gas contract conditions.

Coke continues to be a vital source of energy in the MVMA and APMA member companies foundry operations with a steady 5% to 6% share during the past ten years.

Task Force Activities

In spite of member companies' tight budgets and manpower constraints, the Transportation task force continues its mission with monthly meetings and delivery of technology transfer seminars. For this purpose, the task force includes representatives from Energy, Mines and Resources Canada, the Ontario Ministry of Energy and Ontario Hydro who help finance periodic seminars, such as the 'Energy Savings Today' presentation in September.

The highly successful IDEA EXCHANGE newsletters also continue to provide useful information on energy-related programs.

Future Outlook and Concerns

The task force's mission in the past has concentrated on promotion of energy efficiency for the purpose of cost reduction. This mission must now be broadened to include energy's environmental effects. However, energy efficiency is still viewed as the central issue that needs the primary attention. The voluntary CIPEC organization is therefore seen as the most effective way for government and industry to cooperate in this vital endeavour.

Any expanded or revised monitoring system used to measure changes in energy efficiency and environmental emissions will require very careful consideration. For instance, any thoughts of changing the widely accepted "energy per units of production" measure back to a more obscure GDP reference base would not be acceptable in this sector. This economic-related basis was tried before and didn't work. Manufacturing companies need specific production information for performance comparisons and effective quality control.

As well, the choice of a new base reference year might also require careful study. For example, energy

efficiency comparison between the 1985 boom year and present 1990 recession was untimely for the Transportation Industry Task Force and resulted in an apparently distorted performance picture. The negative result is thought to be largely because of drastic changes in members' businesses and products rather than less efficient use of energy. A similar situation that would question the credibility of results would be unfortunate.

There is also a need to carefully examine the cost of installing environmental improvement projects, particularly when many companies are faced with mounting international competition and loss of business. Environmental solutions are often expensive to implement and use additional energy to operate. A comprehensive analysis is required.

Table I

Energy Efficiency Improvement

Current year (1990) total energy inputs	43,476,662 gigajoules
Base year (1985) equivalent energy inputs	37,223,170 gigajoules
Net Improvement	-16.8%
Efficiency gains 1978-1985	25.6%
1986	2.1
1987	-5.4
1988	-4.9
1989	-6.0
1990	<u>-2.6</u>
Total	8.8

Table II

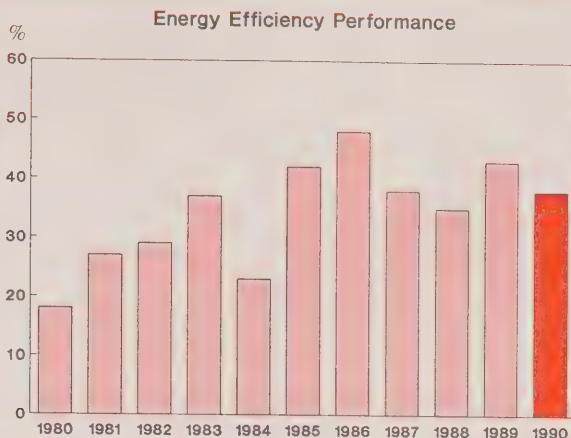
Transportation Industry (Mfg.)

Type	Quantity		Percentage Trends									
	Units	Gigajoules	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981
Natural	23,804,155 m ³	23,804,155	54.7	60.4	57.9	56.7	55.7	54.7	54.5	52.1	53.0	50.9
Electricity	4,077,488 MWh	14,678,955	33.7	28.2	31.5	32.8	30.7	30.1	29.3	28.4	26.9	26.6
Liquid Petroleum Products												
Distillate Oil	5,474,975 litres	213,945	0.5	1.0	1.2	0.6	1.3	1.2	1.2	1.4	1.8	1.4
Crude Oil	n/a	—	—	—	—	—	0.2	—	—	—	—	—
Residual Oil	17,803,147 litres	721,027	1.7	2.2	1.6	1.7	1.8	2.1	3.6	6.3	7.5	10.6
Gasoline	567,198 litres	20,533	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.2
Diesel	830,092 litres	33,121	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.2	0.4	0.1
Turbine Fuel	13,959,176 litres	139,306	0.3	0.2	—	—	—	—	—	—	—	—
Coal	43,668 tonnes	1,187,333	2.7	1.8	1.8	2.2	3.5	3.5	3.8	4.0	3.9	4.7
Coke	85,449 tonnes	2,581,426	5.9	5.5	5.3	5.5	6.1	7.5	7.3	7.2	5.6	5.4
Other Fuels:												
Propane	3,504,856 litres	93,229	0.2	0.4	0.4	0.2	0.5	0.6	0.3	0.3	0.4	0.2
LP	131,027 litres	3,552	0.1	0.1	0.1	0.1	—	—	—	—	—	—
Total		<u>43,476,662</u>										

Wood Products Industry (Western)

Energy Conservation Task Force

R. C. (Dick) Bryan
Chairman



Task Force Description

The Wood Products Industry (Western) Task Force was formed by the Council of Forest Industries of British Columbia (COFI) in 1978 and represents 80 companies with more than 100 sawmills and 15 plywood and veneer mills. COFI members and affiliates account for more than 90% of the total product value of the forest industries in B.C.

Most mills in western Canada are members of industry trade associations which actively pursue a wide variety of business issues of common interest. In British Columbia, the major forest industry associations are the Council of Forest Industries of B.C., its Northern Interior Lumber Sector (NILS), the Caribou Lumber Manufacturers' Association (CLMA) and the Interior Lumber Manufacturers' Association (ILMA). CLMA and ILMA are also affiliate members of COFI.

This survey covers 53 operating sawmills owned by 20 companies, which account for 39% of the lumber produced in B.C. in 1990. The coverage in 1990 represents a reduction from the 1989 survey, which accounted for 47% of the B.C. production. The reporting sample covers mills of all sizes and represents all regions in B.C. as well as an Alberta sawmill.

Goals and Progress to Date

The industry's target for 1990 was a 7% overall increase in energy efficiency from the 1985 base year performance. This goal was achieved in 1989; unfortunately, the overall 1990 performance deteriorated significantly. The overall 1990 performance was 7.9% below that of the 1985 base year, but did represent a 38.8% improvement over the 1978 base year.

Average electrical energy consumption for the production of green lumber increased dramatically in terms of the 1985 base year; a significant deterioration from the energy performance registered in 1989. The 1990 performance, when compared to 1978, also represented a decline of 3.3%.

Compared to 1989, there was a decrease in the average efficiency of natural gas use in the kiln drying of lumber in 1990. When compared with the 1985 base year, however, there was an 7.6% improvement and a 57.8% gain when compared to the 1978 base year.

Lumber Industry Downturn

The lumber industry has not been healthy during the past three years. B.C. lumber production has declined each year since 1987. For the three years combined, on total sales of approximately \$14 billion, the industry lost some \$30 million (marginal profits in 1988 and 1989 were offset by a 1990 loss).

The losses were attributable to three factors: soft markets; a two to three fold increase in stumpage and other forest management charges; and a substantial and sustained rise in the value of the Canadian dollar vs. the U.S. dollar. The impacts of these negative influences have been felt throughout the industry and have resulted in production curtailments and layoffs, but relatively few outright plant closures.

Generally, sawmills in B.C. are designed to run at high volumes of output and relatively low unit costs. When volumes are curtailed, costs rise. Fixed costs, on a per unit of output basis, have risen by 11-40% with a majority of companies in the 20 to 40%

range. Variable cost elements have risen substantially as well.

Even though energy costs typically represent from one to four percent of manufacturing expenses, total production costs rose as high as 17% for many producers in 1990. About 60% of the producers are located in regions where low energy costs represent less than 3% of production expenses. In those companies, with more stable energy cost increases, the focus of attention was on the recession rather than energy conservation.

Improvements in electrical energy conservation performance have proven much more difficult to achieve than for natural gas. Conservation achievements in the use of natural gas have been due to the conversion of kiln-drying systems from natural gas to

wood waste. As long as the sample of reporting mills remains similar from year-to-year, the natural gas conversion achievements are maintained. This is clearly not the case for electricity where conservation gains have been eroded in recent years.

Industry Outlook

The industry appears to be in the early stages of recovery in the second quarter of 1991. Markets have improved considerably. However, it is unlikely that without some decline in the value of the dollar and the introduction of a stumpage system which is sensitive to market conditions, that markets alone will be robust enough to return the industry to health. It is expected, however, that the current recovery will continue and strengthen in 1992.

Wood Products Industry (Western)

Energy Efficiency Improvement

Green Lumber	1990	1985	1978
Total sample production (10^6 board feet-MMFBM)	5482.6	5052.0	4202.2
Total electrical energy consumption (10^{12} J)	3097.3	2241.5	2297.7
Average electrical energy consumption (10^9 J per MFBM)	0.565	0.444	0.547
Current year total electrical energy inputs (10^{12} J)	3097.3	2241.0	2297.7
Comparison base year (1985) equivalent energy inputs (10^{12} J)		2432.6	
Comparison base year (1978) equivalent energy inputs (10^{12} J)		2997.8	
	Improvement (1985 base year) = -27.3%		
	Improvement (1978 base year) = -3.3%		

Kiln Dried Lumber

Total sample production (10^6 board feet-MMFBM)	3937.43	159.4	1013.0
Total electrical energy consumption (mainly natural gas) (10^{12} J)	2800.6	2433.0	1708.8
Average electrical energy consumption (10^9 J per MFBM)	0.711	0.770	1.687
Current year total energy inputs (10^{12} J)	2800.6	2433.0	1708.8
Comparison base year (1985) equivalent energy inputs (10^{12} J)	3032.1		
Comparison base year (1978) equivalent energy inputs (10^{12} J)	6641.9		
	Improvement (1985 base year) = 7.6%		
	Improvement (1978 base year) = 57.8%		

Combined Energy Performance

	1990 Actual	1985 Equivalent	1978 Equivalent
Total electrical energy consumption (Green Lumber) (10^{12} J)	3097.3	2432.6	2997.8
Total natural gas consumption (Kiln Dried 10^{12} J)	2800.6	3032.1	6641.9
Total sector energy consumption (10^{12} J)	5897.9	5464.7	9639.7
	Improvement (1985 base year) = -7.9%		
	Improvement (1978 base year) = 38.8%		

Reporting Companies

Chemicals

Allied Chemicals Canada Inc.
Ashland Chemicals
Atochem Canada Ltd.
BASF Canada Inc.
H. L. Blachford Ltd.
Carbochem Inc.
Canadian Oxy Chemicals
Celanese Canada Inc.
Cyanamid Canada Inc.
Dow Chemical Canada Inc.
DuPont Canada Inc.
Esso Chemicals Canada
Fiberglas Canada Inc.
General Chemical Canada Inc.
B. F. Goodrich Canada Inc.
Hercules Canada Inc.
Himont Canada Inc.
Kemtec Petrochemical Corp. Inc.
Lubrizol Canada Ltd.
Marsulex Inc.
Nitrochem Inc.
Novacor Chemicals Ltd.
Oxychem Canada Inc.
Pétromont Inc.
Polysar Rubber Corporation
Raylo Chemicals Ltd.
Reichhold Limited
Rhone Poulenc Specialty
Chemicals
Rohm & Haas Canada Inc.
Shell Canada Chemical Company
Sulco Chemicals Limited
Surpass Chemicals Ltd.
The Alberta Gas Ethylene
Company
Tioxide Canada Inc.
Union Carbide Canada Limited
Uniroyal Chemicals Inc.
Welland Chemicals Inc.
Witco Canada Inc.

Electrical and Electronic

3M Canada Inc
Alcan Wire and Cable Inc.
Alcatel Canada Wire Inc.
Andrew Canada Inc.
Ascolectic Ltd.

Camco Inc.
Commander Electrical
Materials Inc.
Commander Electrical
Equipment Inc.
Cooper Ind. (Canada) Inc.
Belden Div.
Crouse Hinds Electric
Eaton Yale Ltd., Cutler-Hammer
Industrial Controls
Edwards, a unit of General
Signal Ltd.
Erico Canada Inc.
Ferranti-Packard Transformers
Ltd.
Furnas Electric Company
Garrett Canada
Gennum Corporation
Gould Shawmut Company
Holophane Canada Inc.
Honeywell Ltd.
Iona Inc.
ITT Cannon
Klockner-Moeller Ltée.
Lincoln Electric Co. of Canada
MIL Tracy
Maloney Electric, Div.
Hammond Hold Ltd.
Ouellet Canada Inc.
Philips Electronics Ltd.
Pyrotex of Canada Ltd.
Reliance Electric Ltd.
Smith and Stone (1982) Inc.
Spar Aerospace Ltd.
Temco Electrical Products
Company Inc.
Thomas & Betts Limited
Thomson Consumer Electronics
Canada Inc.
Trench Electric
WCI Canada Inc.

Ferrous Metals

Algoma Steel Corporation
Dofasco Inc.
Sydney Steel Corporation

Food and Beverage

Bakeries

Ben's Limited
Corporate Foods Limited.
Eastern Bakeries Limited
McGavin Foods Limited
Multi-Marques Inc.
Weston Bakery

Biscuit Manufacturers

Christie Brown & Company Ltd.
Colonial Cookies Ltd.
Culinar Inc.
Interbake Foods Limited
Manning Biscuits Ltd.
Windsor Wafers Inc.

Breweries

Amstel Brewing Inc.
Labatt Breweries of Company
Limited
Molson Breweries of Canada
Limited
Moosehead Breweries Limited
Northern Breweries Ltd.
Pacific Western Brewing Co. Ltd
Upper Canada Brewing Co. Ltd.

Confectionery Manufacturers

Adams Brands Inc.
Ganong Brothers Ltd.
Hershey Canada (Montréal) Inc.
Kerr Bros. Limited
Leaf Confections Ltd.
Nestlé Enterprises Ltd.
Trebora Canada Inc.
William Neilson Ltd.
World's Finest Chocolate Inc.
Wrigley Canada Inc.

Distilleries

Alberta Distillers Limited
Canadian Mist Distillers Limited
FBM Distillery Co. Limited
Gilbey Canada Inc.
Hiram Walker & Sons Limited
Joseph E. Seagram & Sons,
Limited
Palliser Distillers Limited

Food Processors

Best Foods Canada Inc.
Campbell Soup Company Ltd.
Hunt-Wesson Canada Ltd.
H.J.Heinz Company of
Canada Ltd.
Kellogg Canada Inc.
Morrison Lamothe Inc.
Nabisco Brands Ltd.
Royal City Foods Ltd.
Snowcrest Packers Ltd.
Sun-Brite Canning Ltd.
Sunland Foods Ltd.
Sun-Rype Products Ltd.
Thomas Canning
(Maidstone) Ltd.
Trebtor Canada Inc.

Fisheries

British Columbia Packers
Limited
Blue Water Seafoods Limited
Connors Bros., Limited
National Sea Products Limited

Grocery Products

Manufacturers

Bovril Canada Inc.
Campbell Soup Company Ltd.
Canadian Home Products Ltd.
Corporation Delico Inc.
Culinar Inc.
General Foods Ltd.
Griffith Laboratories Inc.
Kellogg Canada Inc.
Kraft Ltd.
Lancia Bravo Foods Limited
McCormick Canada Inc.
Monarch Fine Foods Ltd.
Nabisco Brands Ltd.

Meat Processors

Burns Meats Inc.
Canada Packers Inc.
F. W. Fearman Company Ltd.
Intercontinental Packers Ltd.
J. M. Schneider Inc.
Piller Sausages &
Delicatessens Ltd.
Quality Meat Packers Ltd.
Shopsy's Foods Ltd.
Vancouver Fancy Meats Co. Ltd.

Poultry and Egg Processors

Bexel, Division of Co-op.
Fédérée de Québec.
Co-op Dorchester Ltée.
Lashbrook Produce Limited
Lilydale Co-op Limited.
Lilydale Poultry Sales
(Victoria) Ltd.
Lucerne Foods Ltd.
Maple Lynn Foods Ltd.

Soft Drinks

Amalgamated Beverages Ltd.
Beverage Central Inc.
Beverages Lemoyne Ltée
Blackwood's Beverage Ltd.
Canada Dry Bottling
Coca-Cola Bottling
Gray Beverage Mfg. Ltd.
Gray Beverage Inc.
Kitchener Beverages Ltd.
Les Breuvages Deraspe Ltée
Northern Bottling Ltd.
Swift Current Bottlers Ltd.

Sugar Refineries

Atlantic Sugar Limited
British Columbia Sugar Refining
Company Limited
Lantic Sugar Limited
Redpath Sugars Limited

Wineries

André's Wines Ltd.
Inniskillin Wines Inc.
Les Vins La Salle Inc.

General Manufacturing

Metal Processors

Aciers Slater Inc.
Bibby-Ste-Croix Foundries Ltd.
Brass Craft Canada Ltd.
Brown Foundry Ltd.
CAE Machinery Ltd.
Canada Forgings Inc.
Canadian Bronze Company
Limited
C.M.Q.C. Usine de Bouletage
Cooper Tools Limited
Esco Ltd.

Founderies Magotteaux
Canada Ltée
Gray Forgings & Stampings
Limited
Hawker Siddley Canada Inc.
Jenkins Canada Limited
Kubota/Fahramet Inc.
Lake Ontario Steel Company
Limited
Manville Canada Inc.
Magotteaux Canada S.C.C.
Snap-On Tools Ltd.
Teledyne Canada Metal
Products Ltd.
The Canada Metal Company
Limited
Western Foundry Co. Ltd.

Light Manufacturing

AWK Industrial Inc.
AAR-KEL Moulds Ltd.
Arm Industries Ltd.
Armstrong World Industries
Canada Ltd.
Atco Industries Ltd.
Babco Inc.
Black and Decker Canada Inc.
Bombardier Inc.
Commercial Aluminum Ltd.
Dominion Controls Co. Ltd.
Ferro Industrial Products Inc.
Fasco Products, Div. of Indal
General Electric
Kawneer Company of Canada
Limited
Kodak Canada Inc.
Merck Frosst Canada Inc.
NCR Canada Ltd.
Paddle Valley Products Limited
Stanley Acmetrack Ltd.
Tambrans Canada Inc.
Teledyne Canada Metal Products
Limited
Trane Canada Limited

Processing Sector

Ashland Chemicals Inc.
Castrol Canada Inc.
Gates Canada Limited
General Tire Ltd.
Manville Canada Inc.
Michelin Tires (Canada) Ltd.
Trent Rubber Services Limited
Uniroyal-Goodrich Canada Ltd.
Merck Frosst Canada Inc.

Industrial Minerals

Abrasives

Exolon - Esk Co. of Canada Ltd.
General Abrasives - Abrasives
Industries (Canada) Inc.
Norton Advanced Ceramics of
Canada Inc.
Washington Mills Electro
Minerals Corp.

Asbestos

Brinko Mining Ltd., Cassiar
Division
JM Asbestos Inc.
Lab Chrysotile (Bell) Inc
Lab Chrysotile (Lac)
Lab Chrysotile
(BC/KB/Normandie) Inc.

Cement

Canada Cement Lafarge Ltd.
Ciment Québec Inc.
Essroc Cement Limited
Federal White Cement Limited
Genstar Cement Limited
Miron Inc.
St. Lawrence Cement Inc.
St. Mary's Cement Company

Clay Brick and Tile

Briqueterie St-Laurent Ltée
(Div of Jannock Ltée)
Canadian Vitriified Products Ltd.
Estevan Brick Ltd.
Hamilton Brick Ltd.
NSP (Div of NSP Inc.)
IXL Industries Ltd.

Concrete Products

Atlantic Industries Limited
Century Concrete Products Ltd.
Con-Force Structures Limited
Consolidated Concrete
Products Ltd.
Doughty Concrete Products Ltd.
Downey Building Materials Ltd.
Genstar Materials Limited
Richvale Block & Ready-Mix
(Div. of Lafarge Canada Inc.)
Redi-Mix Limited
York Block (Div. of Canada
Cement Lafarge Ltd.)

Glass

AFG Glass Inc.
Consumers Packaging Inc.
Fiberglas Canada Inc.
Libbey St. Clair
PPG Canada Inc.

Lime

Havelock Lime Company of
Canada Limited
Luzenac Inc.
Reiss Lime Company of Canada
Limited
Summit Lime Works Limited
Stelco Steel

Miscellaneous Minerals

Falconbridge Ltd.
Indusmin Limited
3M Canada Inc.
Saskatchewan Minerals Ltd.
Steetley Talc Inc.

Refractories

A. P. Green Refractories
(Canada) Limited
Canadian Refractories Limited
Clayburn Refractories Limited
Continental Refractories
Company Limited
General Refractories Co. of
Canada Ltd.
Manville Canada Inc.

Mining and Metallurgy

Canamax Resources Inc.
Cominco Ltd.
Denison Mines Inc.
Echo Bay Mines Ltd.
Equity Silver Mines Ltd.
Falconbridge Ltd.
Fording Coal Ltd.
Giant Yellowknife Mines Ltd.
Gibraltar Mines Ltd.
Hudson Bay Mining & Smelting
Co. Ltd.
Inco Ltd.
Indusmin Ltd.
Iron Ore Company of Canada
Noranda Minerals Inc.

Central Canada Potash Co. Ltd.
Placer Dome Inc.
Quebec Cartier Mining Ltd.
Rio Algom Ltd.
Syncrude Canada Ltd.
Teck Corporation

Petroleum Refining

Consumers' Co-operative
Refineries Ltd.
Esso Petroleum Canada
Petro-Canada Products Inc.
Shell Canada Limited
Suncor Inc.
Syncrude Canada Ltd.
Turbo Resources Limited
Ultramar Canada Inc.

Plastics

A. Schulman Ltd.
American Biltrite (Canada) Ltd.
Automotive Industries Ltd.
(Donlee)
Beaver Plastics Limited
Bonar Plastics Ltd.
Borden Packaging and Industrial
Limited
Burman-Castrol Canada Ltd.
Canada Cup Limited
Canadian General Tower Ltd.
Celfortec Inc.
Cyro/Chemacryl Plastics Limited
Coastal Plastics Limited
Cryovac/ W. R. Grace Co. Ltd.
Daymond, Div. of Redpath
Industries Ltd.
Duron Plastics Ltd
Fabrakan Inc.
F&H Plastics Ltd.
First Brands Ind. Corp.
Formica Canada Inc.
Horn Plastics Limited
IPL Inc.
Jet Moulding Compounds Ltd.
Les Plastiques Anchor Ltée.
LMG Reliance Inc.
Medallion Plastics Ltd.
Morbern Inc.
Pavaco Plastics Inc.
Pétromont Inc.
Plasti-Drain Ltée.
Plasco Manufacturing Ltd.

Plasti-Fab Ltd.
 Plastiques Cascades Inc.
 Polyainers Inc.
 Polypenco Inc.
 Reinforced Plastics Systems Ltd.
 Relmech Manufacturing Ltd.
 Rohm & Haas Inc.
 Rubbermaid Canada Inc.
 Roll-O-Sheets Canada Limited
 Scepter Manufacturing Co. Ltd.
 Shaw Industries Ltd.
 Schlegel Canada Inc.
 Tupperware Company Inc.
 Union Carbide Performance
 Plastics Ltd.
 Uniplast Industries Ltd.
 Vanguard Plastics Ltd.
 Waltec Plastics Limited

Pulp and Paper

Abitibi-Price Inc.
 Armstrong World Industries Inc.
 Atlantic Packaging Products Ltd.
 Beaver Wood Fibre Co. Ltd.
 Boise Cascade Canada Ltd.
 Bowater Mersey Paper Co. Ltd.
 Canadian Forest Products Ltd.
 Canadian Pacific Forest Products
 Limited
 Cariboo Pulp and Paper
 Company
 Papier Cascades (Cabano) Inc.
 Cascades (East Angus) Inc.
 Cascades (Jonquière) Inc.
 Calgar Pulp Company
 Corner Brook Pulp & Paper Ltd.
 Crestbrook Forest Industries Ltd.
 Diashowa Inc.
 Domtar Inc.
 Donohue Inc.
 Donohue Normick Inc.
 Donohue St. Félicien Inc.
 E.B. Eddy Forest Products Ltd.
 Eurocan Pulp & Paper Co. Ltd.
 Fletcher Challenge Canada Ltd.
 J. Ford & Company Ltd.
 Fraser Inc.
 Gaspesia Pulp & Paper Co. Ltd.
 Howe Sound Pulp & Paper Ltd.
 Irving Pulp & Paper Ltd.
 Island Paper Mills Company
 James River-Marathon Ltd.
 Kruger Inc.
 James MacLaren Industries Inc.

MacMillan Bloedel Limited
 Malette Kraft Pulp & Power Inc.
 Minas Basin Pulp & Power
 Company Ltd.
 Miramichi Pulp & Paper Inc.
 NBIP Forest Products Inc.
 Noranda Forest Recycled Papers
 Northwood Pulp and Timber Ltd.
 Paperboard Industries Corp.
 Perkins Papers Ltd.
 Procter & Gamble Inc.
 Quebec & Ontario Paper Co. Ltd.
 Repap Manitoba Inc.
 Rolland Inc.
 Rothesay Paper Ltd.
 St. Anne-Nackawic Pulp & Paper
 Company Ltd.
 St. Marys Paper Inc.
 Scott Maritimes Ltd.
 Scott Paper Limited
 Skeena Cellulose Inc.
 F.F. Soucy Inc.
 Sonoco Limited
 Spruce Falls Power & Paper
 Company Ltd.
 Stone-Consolidated Inc.
 Stora Forest Industries Limited
 Strathcona Paper Co.
 Tembec Inc.
 Weldwood of Canada Ltd.
 Western Pulp Limited
 Partnership
 Weyerhaeuser Canada Ltd.

Textiles

Albany International Canada Inc.
 BASF Canada Inc.
 Barrday Inc.
 Bell Tootal Inc.
 Bermatex Inc.
 Cambridge Towel Corp.
 Canada Cordage Inc.
 Comdye Inc.
 Consoltex Inc.
 Crossley Karastan Carpet
 Mills Ltd.
 J. L. de Ball Canada Inc.
 Dominion Textile Ltd.
 Drytex, Division of JWI Ltd.
 Dura Undercushion Ltd.
 Harding Carpets Inc.
 Huntingdon Mills Ltd.
 Huyck Canada Ltd.
 Interface Flooring Systems Inc.

LaGran Canada Inc.
 Niagara Lockport Quebec
 Industries Inc.
 Nova Scotia Textiles Ltd.
 Ozite Canada (1981) Inc.
 Patons & Baldwins Canada Inc.
 Peeters Carpets Ltd.
 Poli-Twine Corp.
 Polymer International, a
 Division of Intertape
 Polymer Inc.
 Rayonese Textile Inc.
 Rubyco Inc.
 Rumpel Felt Co. Ltd. (The)
 Satexil Inc. Division Texgram
 Sauquoit Industries Ltd.
 Spinright Yarns & Dyers Ltd.
 Stewart Group Ltd. (The)
 Tapis Coronet Inc.
 Tapis Peerless Ltée
 (Plant No. 3)
 Tapis Venture Ltée
 Tissus Hafner du Canada Ltée
 Tricots Canada U.S. Inc.
 Tricots Duval & Raymond Ltée

Transportation (Mfg.)

*Canadian Maritime
 Industries Assoc.*
 MIL Davie Inc.
 Port Arthur Shipbuilding
 Stone Marine Canada Limited
 Vancouver Shipyards

*Canadian Truck and Trailer
 Mfg. Assoc.*
 Accuride Canada Inc.

Allied Boating Assoc.
 Lund-Larson Boats Canada, Ltd.

*Motor Vehicle
 Manufacturers' Assoc.*
 Chrysler Canada Ltd.
 Ford Motor Company of Canada
 Limited
 General Motors of Canada
 Limited

***Aerospace Industries Assoc.
of Canada***

Aero Machining Ltd.
Airtech Canada
Allied Signal Aerospace Canada,
Garrett Canada
Bell Helicopter, A div. of Textron
Canada Ltd.
Boeing Canada Technology Ltd.
Bombardier Inc. Canadair Div.
CAE Electronique Ltée
Canadian Marconi Company
Chicopee Manufacturing Limited
Donlee Precision
Ebco Industries Ltd.
GE Canada Inc.
Litton Systems Canada Limited
McDonco Machine Limited
McDonnell Douglas Canada Ltd.
Oerlikon Aerospace
Pratt & Whitney
Raytheon Canada Limited
Rolls-Royce (Canada) Ltd.
Spar Aerospace Limited
Walbar Canada Inc.

***Automotive Parts
Manufacturers' Assoc.***

BF Goodrich Canada Ltd.
A. Berger Precision Ltd.
Budd Canada Inc.
Camoplast Inc.
Canada Forgings Inc.
Canadian Autoparts Toyota Inc.
Champion Spark Plugs Ltd.
Cochrane Tool & Design Limited
Daymond Aluminum, A div. of
Daymonex Limited
Degussa Canada Ltd.
Dominion Controls Company
Eaton Yale Ltd.
Fabricated Steel Products.
FAG Bearings Limited
Fahramet-Kubota Metal Corp.
GE Canada Lighting
Gencorp Automotive
Goodyear Canada Inc.
Hayes-Dana Inc.
Hyundai Auto Canada Inc.
ICM/Krebsoge
Johnson Controls Inc.
Kelsey-Hayes Canada Inc.
Numet Engineering Ltd.
Peбра Inc.

Quality Safety Systems Company
Rimply Mfg., A Division of
Decoma Plastics
Rockwell International of
Canada Ltd.
Rustshield Plating Ltd.
SKD Company
Slater Steels Corporation
Tesma International Inc.
Thyssen Marathon Canada Inc.
Torrington, Div. Ingersoll-Rand
Canada Inc.
TRW Canada Inc.

Wood Products

Atco Lumber Ltd.
Canadian Forest Products Ltd.
CIPA Lumber Co. Ltd.
Delta Cedar Products Ltd.
Doman Forest Products Ltd.
Evans Products Co. Ltd.
Federated Co-Operatives Ltd.
Fletcher Challenge Canada Ltd.
Gorman Bros. Lumber Ltd.
Lakeland Mills Ltd.
MacMillan Bloedel Ltd.
Nechako Lumber Co. Ltd.
Northwood Pulp & Timber Ltd.
The Pas Lumber Company Ltd.
Primex Forest Products Ltd.
Repap Smithers Inc.
Riverside Forest Products Ltd.
Slocan Forest Products Ltd.
Stuart Lake Lumber Co. Ltd.
Weldwood of Canada Limited
Zeidler Forest Industries Ltd.

Appendix A

Prefix	Multiple	Symbol
kilo	10^3	k
mega	10^6	M
giga	10^9	G
tera	10^{12}	T
peta	10^{15}	P
exa	10^{18}	E

Energy	Metric	Imperial
Electricity – net	3.6 MJ/kWh	3,414 BTU/kWh
– gross	10.551 MJ/kWh	10,000 BTU/kWh
Natural Gas	37.2 MJ/m ³	1.0×10^6 BTU/MCF
Propane	26.6 MJ/litre	0.1145×10^6 BTU/IG
Crude Oil (#6)	38.5 MJ/litre	5.8×10^6 BTU/bbl
Distillate Oil (#2)	39.0 MJ/litre	0.168×10^6 BTU/IG
Residual Oil (#5)	42.3 MJ/litre	0.182×10^6 BTU/IG
Coal – Bituminous	32.1 GJ/tonne	27.6×10^6 BTU/ton
– Subbituminous	22.1 GJ/tonne	19.0×10^6 BTU/ton
– Metallurgical	29.0 GJ/tonne	25.0×10^6 BTU/ton
Coke – Petroleum (Raw)	23.3 GJ/tonne	20.0×10^6 BTU/ton
Gasoline	36.2 MJ/litre	0.156×10^6 BTU/IG
Diesel Fuel	39.9 MJ/litre	0.172×10^6 BTU/IG
Kerosene	38.8 MJ/litre	0.167×10^6 BTU/IG
Liquid Propane Gas (LPG)	27.1 MJ/litre	0.117×10^6 BTU/IG

To Convert from	to	Multiply by
Cubic Feet	Cubic Metres	0.028
Cubic Feet	Gallons (Imperial)	6.229
Cubic Feet	Litres	28.316
Barrel (Oil)	Cubic Metres	0.159
Barrel (Oil)	Gallons (Imperial)	34.973
Gallon (Imperial)	Litres	4.546
Gallon (U.S.)	Gallons (Imperial)	0.8327
Short ton	Pounds	2000
Short ton	Tonnes	0.9072
Tonne	Short tons	1.102
Long ton	Pounds	2240
Long ton	Tonnes	1.016
Kilogram	Pounds	2.205
BTU	Joules	1055.1
Kilojoule	BTU	0.948
Gigajoule	Barrels Oil Equiv.	0.164

Appendix B

Emission factors - Industrial Fuels

kilograms per Terajoule				
Fuel	NOx	VOCs	SO ₂	CO ₂
Coke	-	-	-	106,330
Coal				
Bituminous	218.069	1.246	1,457.944	86,720
Lignite	0	0	1,628.959	101,680
LFO	61.538	0.615	113.333	73,110
HFO	169.231	3.077	853.428	71,540
Kerosene	61.538	0.615	30.670	67,650
Diesel Oil	57.644	125.313	-	70,690
Nat Gas	60.215	1.183	0.258	49,680
LPG	56.458	1.107	0.148	59,840
Pulp Liquor	68.786	64.487	146.1	70,629
Pet. Ref. Gas	-	-	-	12,080
Fuel Wood	-	-	-	81,470

Sources: Environment Canada Report EPS 5/AP/2, May 1990

Proceedings from Energy Efficiency, Energy Choices

- Lifestyles Work Group, EMR, March 1990.

The information, perspectives and data reported herein are solely the responsibility of the Canadian Industry Program for Energy Conservation Council and the reporting task forces.

The co-operation and support of Energy, Mines and Resources Canada in the preparation of this report are appreciated.

This report is printed on recycled paper.



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Resources Canada

Énergie, Mines et
Ressources Canada

Canadian Industry Program
for Energy Conservation



Lacking 1991/92 ; 1992/93

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Canadian Industry Program for Energy Conservation



Industrial Competitiveness Through Energy Efficiency

1993 - 1994

Annual Report

October 1994

TABLE OF CONTENTS

Chairman's Letter	2	Summary Industrial Energy Efficiency Improvement Targets	25
Executive Overview	3		
CIPEC	7	Canada's Carbon Dioxide Stabilization Challenge: The Rio Accord	26
CIPEC Mission	7		
CIPEC Structure	7	National Action Program on Climate Change	27
CIPEC Policy Board	8		
CIPEC Policy Board's Statement of Principles	9	Carbon Dioxide Baseline Data	27
Task Force Council Chairman's Message	10	Climate Stabilization: The Coming Challenge	28
Task Force Council Representatives	11		
CIPEC Services/Benefits to Industry and Associations	12	International Industrial Energy Efficiency Conference	30
Minister's Advisory Council on Industrial Energy Efficiency (MACIEE)	14	Canadian Industry's Voluntary Energy Efficiency Commitment: Some Examples	30
Canada's Industrial Competitiveness Challenge	16		
Issues for Government and Industry	17		
Energy Intensity	18		
Industrial Energy Base Line Data	19		
Industrial Energy Consumption	20		
Industrial Economic Energy Efficiency by Sector	21		
<ul style="list-style-type: none"> • Pulp & Paper • Petroleum Refining • Steel • Aluminum & Non Ferrous • Chemicals • Mining & Metallurgy • Wood Products • Cement & Lime 	22 22 23 23 23 24 24 25	<u>Appendices</u> CIPEC Manufacturing and Mining Sectors - Standard Industrial Classification (SIC) Codes Sample Letter of Cooperation	 33 34

Chairman's Letter

October 20, 1994

The Honorable Anne McLellan
Minister of Natural Resources
House of Commons
Ottawa, Ontario K1A 0A6

Dear Minister

I take pleasure in enclosing CIPEC's 1993 - 1994 Annual Report.

The themes of this report are:

- improving industrial competitiveness in an increasingly competitive world through increased energy efficiency, and
- industry's contribution to Canada's goal of stabilizing carbon dioxide emissions at 1990 levels by the year 2000.

The past year has been one of accomplishment. The CIPEC Policy Board was established. As well, your Advisory Council on Industrial Energy Efficiency (MACIEE) was formed and has met twice.

In renewing its voluntary industrial energy efficiency challenge, CIPEC concentrated its initial efforts on the 8 most energy intensive manufacturing and mining sectors, accounting for over 91 per cent of industrial energy use in Canada. These sectors represent the best opportunities for making the maximum contribution to Canada's greenhouse gas stabilization goal.

Subsequently, CIPEC added Task Forces from less energy intensive sectors. More than 12 sectors are now actively represented on CIPEC's Task Force Council.

The final phase of this activity will involve recruiting the remaining industry sectors. When complete, some 25 sectors will be represented in the CIPEC Policy Board and Task Force Council.

Of paramount importance this past year has been the development of baseline data on industrial energy use and carbon dioxide emissions.

As well, CIPEC created a number of value-added services to assist industry improve energy efficiency and thereby assist Canada meet its international commitment to stabilize carbon dioxide emissions at 1990 levels by the year 2000.

Industry's commitment to voluntary energy efficiency builds upon a very successful past.

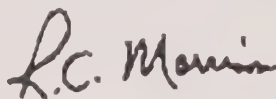
From 1973 to 1990, industry reduced the amount of energy required to produce each unit of production by 26.1 per cent. In total this was a reduction of 30 million tonnes of carbon dioxide per year. Energy use for the period 1990 to 1992, a recession period, was virtually flat.

For its part, government needs to ensure there is a conducive business environment within which industry can invest in economic energy efficiency technology and equipment, increase economic growth and job creation.

The task ahead is formidable but industry's accomplishments to date, as reflected in the Executive Overview which follows, provide an excellent base for further energy efficiency and CO₂ emission reductions in the years ahead.

CIPEC looks forward to continuing its close working relationship with you and your officials.

Yours sincerely,



Ron Morrison
Chairman, CIPEC Policy Board

Executive Overview

- From 1975 to 1990, industry reduced its energy use per unit of production by 26.2 per cent for an average annual reduction of 1.6 per cent. This is equivalent to an annual on-going reduction of 30 million tonnes of carbon dioxide emissions.
- In 1992, CIPEC was restructured and, while continuing its emphasis on energy efficiency, it also focused on carbon dioxide emission reduction.
- Despite the recession, many industry sectors continued to work on energy efficiency improvements. As a result, industry's share of Canada's total energy use fell from 28.5 per cent in 1990 to 28.2 per cent in 1992
- Canadian industry's preliminary annual energy efficiency improvement target, for the period 1995 - 2000, is 1 per cent. Definitive targets, by industry sector and industry as a whole, will be available in 1995.
- Carbon dioxide emissions from Canadian industry fell by 1.39 per cent between 1990 and 1992 from 71.48 million tonnes to 70.49 million tonnes.
- CIPEC initiated the development of an industry/government energy use and efficiency measurement system: a world first!
- 3,000 companies now participate in CIPEC, up from 700 during the 1975 to 1990 period.

CIPEC is a Voluntary,
Industry Driven
Initiative

CIPEC is a voluntary industry led organization currently involving 12 of Canada's manufacturing and mining sectors. It is supported by government and industry associations, representing over 3,000 companies. Its focus is industrial energy efficiency, competitiveness and to assist Canada meet its carbon dioxide stabilization target.

CIPEC was created in 1975 and reorganized in 1992 as a result of the implications for industry arising from the United Nations Framework Convention on Climate Change - the Rio Accord.

Focus on Energy
Efficiency and
Competitiveness

Canadian industry measures its performance on energy efficiency per unit of production.

According to the World Competitiveness Report, Canada's competitiveness ranking among OECD countries dropped from 5th in 1990 to 14th in 1994. Energy costs vary as a percentage of total production costs for different sectors; in some sectors they can be as high as 20 to 30 per cent. The incentive to improve is powerful.

Executive Overview

1990-1992 Industrial
Energy Consumption
Flat

Between 1990-1992, a recession period in the manufacturing and mining sectors, total Canadian industrial energy use was:

	<i>% of Canada's Total Energy</i>
1990: 2,184,765 Terrajoules	28.5%
1992: 2,183,737 Terrajoules	28.2%

Federal Government
Challenge

Canadian industry, through the CIPEC Policy Board, accepted the April 29, 1994 challenge of the Minister of Natural Resources Canada to voluntarily commit to improve energy efficiency.

8 Major
Manufacturing and
Mining Energy Users:
1990-1992

Eight industrial sectors surveyed by CIPEC consumed over 90 per cent of all industrial energy.

Industrial Energy Efficiency Index
(Energy Use Divided by Output: 1990 Equals 100.
A negative per cent indicates an improvement)

<u>Sector</u>	<u>'90</u>	<u>'91</u>	<u>'92</u>	<u>% Change</u>
Mining/Metallurgy	100.0	96.8	89.7	-10.3
Aluminum/Other				
Primary Metals	100.0	99.0	90.9	-9.1
Pulp & Paper	100.0	99.15	98.2	-1.8
Wood Products	100.0	100.6	99.1	-0.9
Cement/Lime	100.0	96.4	101.4	+1.4
Steel	100.0	114.1	103.3	+3.3
Chemical	100.0	*	106.1	+6.1
Petroleum Refining	100.0	100.6	106.3	+6.3

* See Figure 11, page 23

From 1990 to the end of 1992, taken as a group, energy efficiency in the eight largest energy using sectors remained constant.

Industrial Carbon
Dioxide Emissions
Reduced

By the end of 1992, carbon dioxide emissions attributed to Canadian industry were less than 1990 levels by almost a million tonnes, a 1.39 per cent reduction. Similarly, industry's share of Canada's total carbon dioxide emissions fell by 0.5 percentage points:

	<i>% of Canada's Total CO₂</i>
1990: 71.48 million tonnes	15.49%
1992: 70.49 million tonnes	14.98%

Executive Overview

CIPEC Policy Board	<p>CIPEC's Policy Board was established in 1993. The Board, with links to industry associations, represents over 90 per cent of Canada's manufacturing and mining energy use. The Policy Board is CIPEC's governing body where industry representatives set overall policy direction and monitor progress.</p>
<p>Minister's Advisory Council on Industrial Energy Efficiency (MACIEE)</p>	<p>The Minister of Natural Resources Canada's Advisory Council on Industrial Energy Efficiency (MACIEE) was established as a forum for senior industry executives to meet at least annually with the federal Minister of Natural Resources to discuss industrial energy issues. MACIEE met twice in 1994.</p> <p>Most Policy Board members are also members of MACIEE.</p>
CIPEC Task Force Council	<p>CIPEC's Task Force Council, made up of operating managers from manufacturing and mining, has been reconstituted and currently represents 12 manufacturing and mining sectors.</p>
Credible Baseline Data	<p>CIPEC has forged an industry/government alliance to initially develop and, thereafter, collect accurate, credible and impartial baseline data on energy use by the manufacturing and mining sectors.</p> <p>The Canadian Industry Energy End-Use Data and Analysis Centre (CIEEDAC), Simon Fraser University, is the repository of this information.</p> <p>By mid-1995, it is expected that credible baseline data on all major industrial sectors will be available.</p>
<p>Five New CIPEC Services</p>	<p>CIPEC provides a variety of services to industry, including:</p> <ul style="list-style-type: none"> • On-Site - energy efficiency assistance at minimal cost • energy efficiency training for employees (CIET) • technology development (CANMET) • a completely revised and updated Energy Management Guide • industrial technology advice

Industrial Energy
Efficiency
Conference

CIPEC sponsored an important International Industrial Energy Efficiency Conference on April 29, 1994.

Externalities
Collaborative

CIPEC represented industry's interests in an Ontario natural gas Externalities Collaborative examining, among other things, the value which should be placed on carbon dioxide emissions.

International
Energy Agency

CIPEC represented Canada on an International Energy Agency Steering Committee which developed the 1994 International Industrial Energy Efficiency Conference in Washington..

13 Industry
Associations Sign
Energy Efficiency
Letters of Cooperation

13 industry associations have signed Energy Efficiency Letters of Cooperation (LOCs) with CIPEC. These associations have undertaken to encourage their member companies to develop and implement plans for energy efficiency as a means of becoming more competitive, thereby participating in helping to meet Canada's carbon dioxide emission stabilization goal.

Summary Results:
1990 - 1992

Voluntary industrial energy efficiency improvement activity is continuing to make progress.

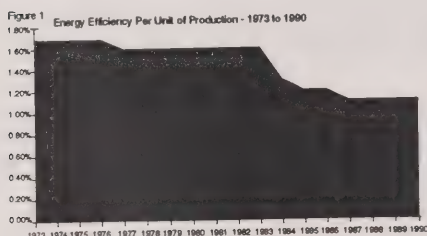
CIPEC **(Canadian Industry Program** **for Energy Conservation)**

CIPEC is a voluntary initiative of industry, supported by government, energy utilities and industry associations, promoting and monitoring energy efficiency throughout Canada's manufacturing and mining industries.

CIPEC was created in 1975 when energy security and high energy prices were major concerns.

From 1973 to 1990, Canadian industry voluntarily reduced energy consumption per unit of production by 26.2 per cent, an average annual reduction of 1.6 per cent. See Figure 1. This is equivalent to 30 million tonnes of carbon dioxide emissions avoided per year.

Figure 1



Today, energy efficiency, global competitiveness and the need to contribute to stabilizing energy related carbon dioxide emissions are key motivating forces.

CIPEC now represents the energy related interests of more than 3,000 manufacturing and mining companies which account for over 90 per cent of Canada's total industrial energy use. It is a single, major voice for Canadian industry on energy efficiency.

CIPEC is governed by a 17 member Policy Board. Most members also advise the Minister of Natural Resources Canada through participation in the Minister's Advisory Council on Industrial Energy Efficiency (MACIEE).

Industry's voluntary energy efficiency initiatives are coordinated by a 12 member Task Force Council.

CIPEC's Policy Board and Task Force Council are supported by a small Secretariat.

CIPEC's Mission

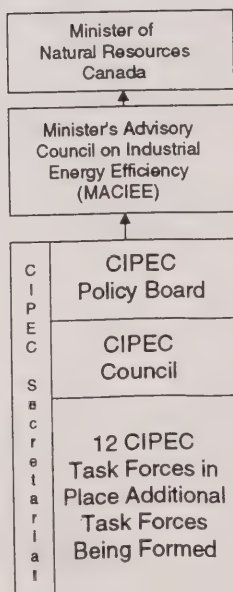
In 1992, CIPEC refocused its mission to incorporate the new realities. CIPEC's mission is:

To promote effective voluntary action which enhances industrial energy efficiency and economic performance while participating in meeting Canada's CO2 stabilization objectives.

CIPEC's Structure

Figure 2 illustrates CIPEC's Policy Board, Task Force Council, and Secretariat. It also shows the relationship of the Policy Board to the Minister's Advisory Council on Industrial Energy Efficiency.

Figure 2



CIPEC Policy Board

CIPEC's governing body is its Policy Board with representation from 17 different sectors of manufacturing and mining. The Board sets CIPEC's overall policy direction and monitors progress and accomplishments.

The Minister of Natural Resources Canada draws extensively from the CIPEC Policy Board for the membership of the Minister's Advisory Council on Industrial Energy Efficiency (MACIEE).

Policy Board Membership

CIPEC's Policy Board includes:

Chairman

Ron Morrison, President & General Manager, Kodak Canada Inc.

Brent Ballantyne, President, CEO
Maple Leaf Foods

Claude Chamberlain, Exec. V.P.
Alcan Aluminum Limited

Alex Geddes, President,
Joyce Furniture Inc.*

Chuck Hantho, Chairman, CEO
Dominion Textiles Ltd.

Yves Landry, President, CEO
Chrysler Canada

David Larkin, President, CEO
Honeywell Limited

Emmie Leung, President, CEO
International Paper Industries Ltd.

Ron Munkley, President
Consumers' Gas Company

Michael O'Brien
Executive Vice President
Suncor Inc.

Frank Pickard, President, CEO
Falconbridge Ltd.

John D. Redfern, Chairman
Lafarge Canada Ltd.

Robert Schad, President
Husky Injection Molding Systems Ltd.

Brenda Schiedel, President & CEO
Coyle & Greer Awards Canada

Fred Telmer, Chairman, CEO
Stelco Inc.

Peter Torbet, Chairman
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Carol Troyer, President &
General Manager, Rubbermaid Canada
Inc.*

Stephen Van Houten, President
Canadian Manufacturers' Association

George Weyerhaeuser, Jr., President,
CEO
Weyerhaeuser Canada Ltd.

* Retired

CIPEC Policy Board Submission to the Minister

In October 1994, the CIPEC's Policy Board advised the Minister of Natural Resources Canada that industry is committed to reducing energy use per unit of production between 1995 and the year 2000.

This commitment is on an industrial sectors basis, based on the analysis of the CIPEC sector task forces shown later in this report.

Because the industrial energy base line data issue will not be resolved until 1996, on sector basis, the size of Canada's carbon dioxide "gap", if any, will not be known until then.

The setting of targets is a continuous process and the Task Forces will be constantly refining them over the coming months.

CIPEC Policy Board's Statement of Principles: National Action Program

Industry is a major consumer of energy. Such energy use is vital to Canada's social and economic well-being.

Every effort, however, must be taken to reduce the amount of energy which Canadian industry requires to produce a unit of production. Such reduction makes industry more competitive and reduces environmental emissions.

How we institute our energy reduction programs will determine whether Canadians can be competitive and still meet our international obligations.

Set out below are eight key principles on which energy efficiency and related greenhouse gas emission public policy should be based.

- A voluntary industry program must be a cornerstone of Canada's National Action Program on Climate Change.

Voluntarism allows industry the flexibility to adopt measures that contribute to competitiveness, while helping Canada meet its greenhouse gas stabilization objectives.

For governments, a voluntary approach offers more timely, lower cost responses than regulation. Voluntarism encourages cooperation and commitment from a broad cross-section of society.

- Co-ordinated federal, provincial and municipal actions on greenhouse gas stabilization initiatives are essential for the success of Canada's National Action Program on Climate Change.
- Measures to achieve international climate change goals must be consistent with Canada's national interests and other public policy objectives.
- Climate change actions must be designed to maintain Canada's competitiveness abroad and its job market at home.

Any Canadian measures to stabilize or reduce greenhouse gas emissions must be coordinated and harmonized with Canada's major trading partners, especially U.S. and Mexico, to ensure that Canadians are not placed at a disadvantage.

- Differences between industrial companies and sectors will inevitably mean that some firms and sectors will successfully achieve the 1990 greenhouse gas stabilization target, while others might only be able to slow the rate of increase in emissions. Governments must recognize this reality and pursue an overall Canadian program.
- Canada must have authoritative industrial energy baseline data by industrial sector. Such data does not exist for the period 1990 to 1993. Moreover, it will be at least mid-1995 before authoritative disaggregated 1994 industrial baseline information becomes available from Statistics Canada (StatsCan). Policy decisions taken in the absence of a clear understanding of industrial energy baseline data are inappropriate and could damage the economy.

Working in cooperation with StatsCan, the Federal departments of Environment and Natural Resources, and the Canadian Industrial Energy End-Use Data Base and Analysis Centre (CIEEDAC) at Simon Fraser University, CIPEC is playing the lead role in developing an industrial energy data base on energy consumption and related CO₂ emissions.

- Authoritative industrial sector baseline data is also a prerequisite to the international benchmarking of best energy efficiency practices.
- Broad public debate, understanding and commitment to the economic and social implications of additional measures to reduce greenhouse gas emissions beyond the 1990 level is required before Canada makes further international commitment.

CIPEC Task Force Council: Chairman's Message

Canadian industry has once again accepted the challenge to play a significant role in reducing its energy use. The first time, in 1975, the issue was the real potential for energy shortages.

This time the challenge comes from the environment and Canada's commitment to stabilize greenhouse gas emissions, measured in terms of carbon dioxide emissions, at 1990 levels by the year 2000.

As Chairman of the CIPEC Task Force Council for the past eight years, I have had the privilege of participating in the transition from the old to the new CIPEC.

It has been a major undertaking, but one which industry has accepted willingly. The task is not yet over. In fact, it has really just begun.

There are many difficult issues still to be resolved.

First, the impact of increased production to meet increased demand for Canadian products, the availability of financial and technical resources to respond, as well as to invest in new energy efficiency technologies, energy intensity/mix, etc., will vary between companies and sectors.

A prerequisite to understanding the impact of current industry initiatives is the availability of agreed upon baseline data by industry sector. This is required to establish industrial reduction targets and monitor progress as measured by energy consumption by unit of output.

Second, it is essential that a method be developed to compare Canada's industrial energy use and related carbon dioxide emission performance with other countries. No such system now exists.

Third, it is essential that industry take responsibility for energy efficiency and related carbon dioxide emissions that are

under its control. Similarly, Canadian industry should not be asked to assume responsibility for activities it cannot control.

Fourth, it is essential that energy efficiency initiatives be based on economic efficiency, not on some arbitrary reduction target.

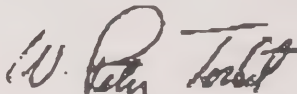
There has been excellent cooperation among industry, utilities and government, establishing a good base for the future.

Today, 12 industry sectors, comprising 3,000 companies, are represented on the Task Force Council through the Chairperson of each Task Force.

The Council brings industry together, individually or through sector associations, to assess issues, recommend policy to the Policy Board, plan, implement and monitor action.

Electricity and natural gas utilities and representatives from the federal and Ontario governments are associate members of the Council.

I salute all those who have so willingly volunteered their time and effort to the progress which CIPEC and Canadian industry has made in the past year.



Peter Torbet
Chairman, CIPEC Task Force Council

CIPEC Task Force Council Representatives

Electrical and Electronic

Steve Horvath
Honeywell, Limited

Ferrous

Susan Olynyk
Dofasco Inc.

General Manufacturing

Jon Fenwick
Canadian Manufacturers' Association

Industrial Minerals

John M. Lind
St. Mary's Cement Company

Mining & Metallurgy

John Owen
Falconbridge Limited

Petroleum Refining

Associate Members

Chemical

David Shearing
Canadian Chemical Producers
Association

Utilities

William Hale

Bob Clapp
Canadian Petroleum Products
Institute

Plastics

Nabil Mustafa
Canadian Plastics Institute

Pulp and Paper

Michael Frost
Canadian Pulp and Paper Association

Textiles

Eric Barry
Textile Institute

Transportation

Ken Rossi
Ford Motor Company of Canada

Wood Products

R. C. (Dick) Bryan
Council of Forest Industries
of British Columbia

Ontario Hydro

Robert Huggard
Canadian Gas Association

Government

Linda Ploeger
Ontario Ministry of Environment and
Energy

Richard McKenzie
Natural Resources Canada

CIPEC Services / Benefits To Industry

Canadian industry, through CIPEC, works with government and other stakeholders in a voluntary initiative to improve energy efficiency and, thereby, to improve industrial competitiveness and help achieve Canada's greenhouse gas emission stabilization goals.

CIPEC provides a variety of services to industry. These are illustrated in Figure 3 which follows, including:

- establishment of accurate and reliable baseline data collection and tracking systems
- supporting industry establish voluntary, sector by sector energy efficiency improvement targets and track progress towards those goals
- identifying opportunities for technology transfer
- energy efficiency training through the Canadian Institute for Energy Training (CIET)
- energy management personnel available through On-Site.

On-Site is an initiative supported by the federal government whereby an unemployed professional, with appropriate background and experience, is chosen by a company to go "on staff but not on payroll" for a six month in-house energy management training experience. During this period, he/she

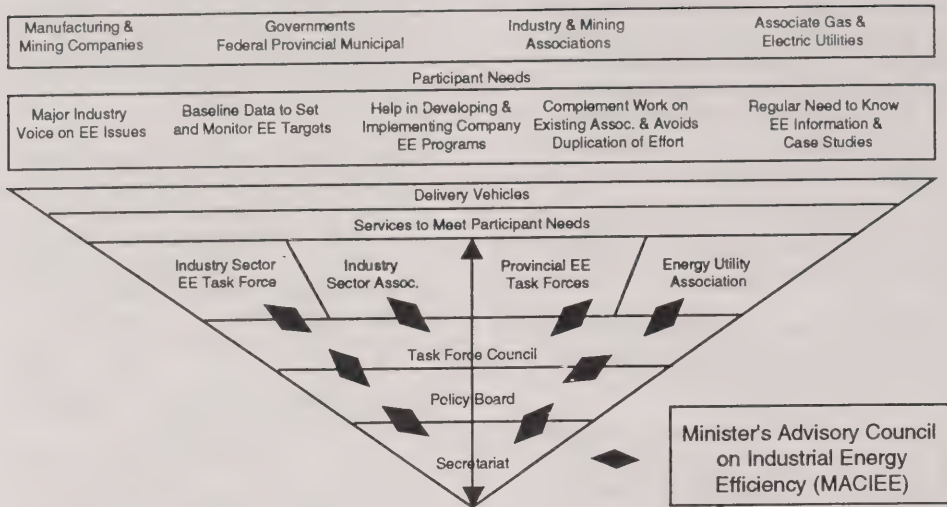
receives unemployment insurance.

More than 35 percent of these workers go on permanent staff at the end of the training period and more than two-thirds of them are ultimately employed by others in their particular fields.

- representing industry views, for instance, at the Ontario Energy Board, the Climate Change Task Group, the Natural Gas Externalities Collaborative, and at natural gas utility Demand Side Management consultative meetings.
- an updated Guide on Energy Management for industry
- services of an industrial technology advisor to assist companies or task forces with their energy efficiency problems
- developing industrial energy efficiency case histories
- arranging for Energy Performance Contracting assistance, including third party, off-balance sheet energy efficiency financing
- providing monthly industrial energy efficiency news and information in "Plant" newspaper
- regular information exchange with governments, utilities and others on energy efficiency issues, thereby ensuring the energy efficiency activities of these organizations are better coordinated.

CIPEC Services To Industry

Figure 3
The CIPEC Process: Services to Industry



Benefits to Companies Participating in CIPEC

Industry benefits from CIPEC as a result of:

- a coordinated, voluntary industry response to a government priority
- a single focus for industry action rather than a company having to appoint representatives to a multitude of association energy committees all trying to attain the same goal
- ensuring accurate, credible and cost-effective data gathering by industrial sector
- providing credible analysis of data through the Canadian Industrial Energy Efficiency End-Use Database and Analysis Centre (CIEEDAC)
- a strong industry voice for realistic solutions to complex energy efficiency issues
- annual recognition of industry achievement

Benefits to Industry Associations from Participation in CIPEC

Industry associations benefit from participation in CIPEC because:

- CIPEC complements industry association mandates to safeguard the interests of their members
- in an era of financial restraint, CIPEC avoids needless duplication of effort
- an industry association can appoint a sector representative to the CIPEC Policy Board thereby ensuring the industry's perspectives are taken into account
- CIPEC ensures that the accurate measurement of industry sector progress is achieved in a cost-effective way.

Minister's Advisory Council on Energy Efficiency (MACIEE)

MACIEE is a forum for senior industry executives to meet, at least annually, with the federal Minister of Natural Resources to discuss energy efficiency issues.

MACIEE enables industry to contribute to government policy development.

It fosters a partnership for the achievement of common economic and environmental goals.

CIPEC's Policy Board comprises most of the MACIEE's membership.

MACIEE met for the first time on February 7, 1994.

MACIEE's Role

MACIEE develops principles, concepts and strategies that, through energy efficiency, enable Canadian industry to contribute to the national goal of stabilizing Canadian greenhouse gas emissions at 1990 levels by the year 2000.

IN A WAY THAT

Sector by sector industrial contributions to "greenhouse" gas emissions and their reduction are both understood and appropriate to each sector

Fully examines alternate energy sources as potential solutions to this problem

Supports the principle of "Sustainable Development"

Builds on Canada's natural advantages

Is aligned with the principles and objectives of other federal and provincial departments; specifically of energy,

environment, industry and international trade.

- Develops a specific time table for this work as part of the larger goals.
- Does not undermine industry's competitive position.

SO THAT

Canadian industry may contribute to the Nation meeting its international commitment on greenhouse gas emissions without diminishing Canada's industrial competitive position.

***Minister's Advisory Council
on Energy Efficiency
(MACIEE)***

MACIEE draws heavily from the CIPEC Policy Board for its membership and includes:

Chairman
Ron Morrison, President & General
Manager, Kodak Canada Inc.

Brent Ballantyne, President, CEO
Maple Leaf Foods

Claude Chamberlain, Exec. V.P.
Alcan Aluminum Limited

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CEO, Weyerhaeuser, Canada Ltd.

* Retired

Canada's Industrial Competitiveness Challenge

According to the World Competitiveness Report, Canada's competitiveness ranking among OECD countries dropped from 5th in 1990 to 14th in 1994.

Energy costs vary as a percentage of total production costs for different sectors; in some sectors they can be as high as 20 to 30 per cent.

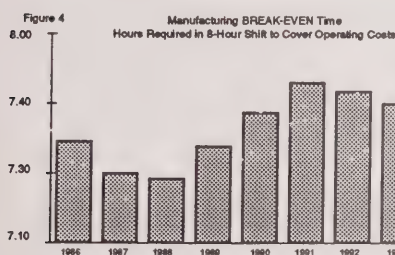
Canada's mining and manufacturing company's contributed 20 per cent of the GDP in 1993, down from 25 per cent in 1985.

Industrial and mining employment has fallen from 18.8 per cent of the workforce in 1985 to 15.0 per cent in 1993.

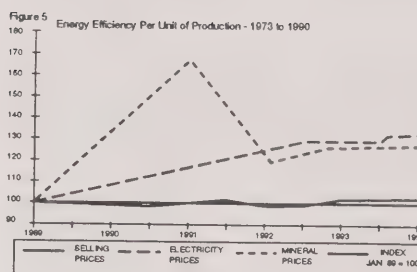
These are the results of declining competitiveness.

Manufacturers had to work seven hours and fifty minutes in 1993 just to cover operating costs.

While this is slightly better than 1991 and 1992, it is over 25 minutes a day longer (5%) than it was in 1988. See Figure 4.



Nor is there room to pass price increases onto customers. As Figure 5 illustrates, selling prices since 1989 have remained flat, while energy prices - electricity, oil, natural gas, and coal (mineral fuel), have increased significantly.



In today's highly competitive market, energy efficiency represents a relatively easy and cost-effective way of enhancing industry's bottom line thereby improving its industrial competitiveness.

CIPEC's challenge is to convince all of industry of the need to pursue this opportunity.

Issues for Government and Industry

More efficient energy use between now and the year 2000 to stabilize carbon dioxide levels at 1990 levels will require significant effort and investment. For some it may require lifestyle changes.

Canadian industry will continue to play its part. In doing so, it is important that all Canadians appreciate that choices among competing objectives will need to be made.

For example, increased investment by Canadian industry to meet unrealistic greenhouse gas reduction goals may result in the cost of doing business in Canada rising relative to other countries, making Canadian industry and their products uncompetitive.

This could result in fewer jobs, less job security and a lower standard of living.

Energy efficiency and greenhouse gas stabilization cannot be dealt with in isolation of other objectives Canadians want to achieve.

These are issues which government needs to address in addition to committing to the goal of stabilizing greenhouse gas emissions at 1990 levels by the year 2000.

How far Canadians are willing to go to achieve the greenhouse gas stabilization goal is a question which has not yet been put to them. It should, so the debate can result in reasoned public policy decisions.

According to the Climate Change Measures Working Group report, to achieve reductions of the magnitude some are suggesting beyond 2000 would result in changes to the very framework of society.

Before committing to new, more stringent carbon dioxide emission targets, Government's obligation is to

communicate to Canadians an understanding of the implications on:

- the environment as confirmed by informed scientific knowledge
- living standards
- jobs
- exports of energy intensive products.

Canada's Industrial Energy Efficiency Challenge: Energy Intensity

Canada is often characterized as an "energy hog" because it consumes more energy than many other countries.

At issue are three different concepts: energy intensity, energy efficiency and economic efficiency.

Energy efficiency is a measure of energy used per unit of output. The measure is valid when the output is a micro level unit, i.e., tonnes of cement, tonnes of steel, etc.

The measure is ambiguous and confusing, however, when output is a macro level unit, i.e., GDP. The macro level of energy intensity is more a measure of the standard of living of a country than the effectiveness of energy use.

When Canada's industrial energy performance is compared with other countries, the measure is the relative energy intensity. For example, Canada is more energy intensive than Japan.

Such comparisons are, inappropriate and misleading. Canada is a resource based economy, using large amounts of energy to produce pulp and paper, aluminum, lead and zinc and other resource based products.

A significant proportion of these products is exported, along with the energy required to make them.

Energy intensity can also measure energy used to produce output in specific production processes and industries. This definition of energy intensity is appropriate.

Energy efficiency, on the other hand, is concerned with using the least possible amount of energy to produce a given output, regardless of the cost of the investment required to achieve the lowest amount of energy possible per unit of output.

In a competitive world, however, production decisions are based on relative costs, i.e., economic efficiency, not energy efficiency alone.

By any measure, many Canadian industrial sectors rank among the most energy efficient in the world.

In fact, the energy efficiency of some Canadian industry sectors is being increasingly recognized by various foreign industries which are beginning to export raw materials to Canada for further processing.

While this activity also recognizes the abundant supply of Canadian energy at competitive prices, it ultimately results in more energy use and increased CO₂ emissions in Canada and less in those other countries. A benefit of this is that, in a global context, less CO₂ is produced.

Unless domestic consumption and industrial exports are taken into account, energy intensity comparisons among countries are misleading and inappropriate.

High energy intensity does not necessarily imply inefficient use of energy.

Energy efficiency without reference to economic efficiency can result in an uncompetitive economy.

Canada's Industrial Energy Efficiency Challenge: Base Line Data

To measure accurately Canada's industrial energy consumption, it is essential there be broad agreement on:

- the definition of industry
- the total energy consumed by Canadian industry and by sector as at 1990, and on
- a reporting system which can track the amount of energy used in each year, by industrial sector and by each region of the country.

CIPEC, working with the Canadian Industry Energy End-Use Database and Analysis Centre of Simon Fraser University, NRCan, StatsCan, and Environment Canada, is playing the lead role to establish such a system.

Progress is being made, but it will be mid-1995 at the earliest before an accurate energy use data collection system is in place.

Until then, it is inappropriate for government to make policy decisions based on current data.

Industrial Energy Defined

Industrial energy is defined as energy used to produce manufactured or mined products. This includes stationary applications, purchased and non-purchased fuels (including biomass).

Appendix 1 identifies the manufacturing and mining sectors, by Standard Industrial Classification (SIC) code, which are the scope of CIPEC's activities.

CIPEC's baseline data collection and analysis is being undertaken by SIC codes in three phases. The information in this report reflects phase 1, representing over 91 per cent of total industrial energy use.

The data presented in this report is based in CIEEDAC data, derived from a variety of sources including the Annual Survey of Manufacturers, Industrial Consumption of Energy (ICE), and quarterly reports on Energy Supply and Demand (ESD).

Phase 2 will result in preliminary targets being set for additional SIC code sectors in 1995. Phase 3 will result in preliminary targets for the remaining SIC sectors where energy use and efficient measurement is statistically viable and cost effective.

Canada's Industrial Energy Efficiency Challenge: Energy Consumption

Between 1990 and the year 2000 Canada's commitment is to reduce its national carbon dioxide emissions to 1990 levels.

Canadian industry's challenge is to contribute to that national goal.

Figure 6 lists the principal industrial energy using sectors, in descending order of energy consumption.

Figure 6

1992 Industrial Energy Use by Sector

Rank	Industrial Sector	Tera joules (000)	% of All Industry
1	Pulp & Paper Non biomass	824.3* 390.54**	37.7
2	Petroleum Refining	311.70	14.3
3	Steel	222.31	10.2
4	Aluminum & Non-Ferrous	222.06	10.2
5	Chemicals	171.87	7.9
6	Mining/ Metallurgy	118.96	5.4
7	Wood Products	66.11	3.0
8	Cement/Lime	54.48	2.5
	Sub Total	1991.79	91.25
9	All Other Sectors***	191.95	8.79
	Total All Industry	2,183.74	

Source: Statistics Canada and CIEEDAC

* includes biomass ** excludes biomass

*** For the most part the energy use in these other sectors is too small to statistically measure by StatsCan's ICE survey. CIPEC will work with other associations to encourage smaller users to greater energy efficiency.

Eight industrial sectors - pulp and paper, petroleum refining, steel, chemicals, aluminum and non-ferrous, mining and metallurgy, wood products and

cement/lime - consume over 90 per cent of Canada's industrial energy.

Industrial energy use between 1990 and 1992 was virtually flat, resulting in industry's share of Canada's total energy falling to 28.2 per cent in 1992 from 28.5 per cent in 1990:

% of
Canada's
Total
Energy

1990: 2,184,765 Terajoules 28.5%
1992: 2,183,737 Terajoules 28.2%

Four of the eight major industrial sectors - mining, aluminum/non-ferrous, pulp and paper and wood products - saw a reduction in the amount energy consumed between 1990 and 1992.

Four sectors -cement/lime, petroleum refining, chemicals and steel - saw an increase.

Canadian Exports of Embodied Energy and Related Carbon Dioxide Emissions

Canada is a major exporter, particularly of processed or semi processed natural resources. As a result, Canada exports a significant amount of energy in the form of manufactured or refined product. This is called "embodied energy".

Canada's energy consumption statistics should therefore reflect this fact, and the embodied energy contained in exports, and related carbon dioxide emissions, should be charged to importing countries.

How this can be achieved is now being examined by CIPEC.

Canada's Industrial Economic Energy Efficiency Challenge: By Sector

CIPEC has 12 industrial sector task forces currently in place charged with finding ways to reduce energy consumption per unit of production.

Eight of these sectors are the principal industrial energy users, comprising over 90 per cent of all industrial energy use.

By April 1, 1995, additional industrial sector task forces are expected to be in operation.

The following is a status report on these eight sectors. The data presented below has been reviewed by each of the Sector Task Forces involved and the respective trade associations.

As well, seven of these sectors have set preliminary annual energy efficiency improvement estimates for the period 1995 to 2000.

These estimates are based on best estimates of opportunities for improvement and the expectation that past progress will continue.

Because of the lack of accurate baseline data and the limited time available, these estimates are tentative and conservative.

As well, they are not yet based on a detailed assessment of specific measures and their impact. Such assessments are currently being undertaken by the sector Task Forces.

As greater experience is gained, it is expected that these estimates will be revised.

In part, these estimates will employ an improved, more representative Statistics Canada data collection sample for each sector. Overall, the data collection sample size will triple.

Some Key Assumptions

Definitive targets for each sector will also depend on the outcome of a number of key assumptions, including that:

- Canada will remain a stable political entity, economically and culturally
- there will be no significant regulatory effects that will shift product consumption (e.g., steel to wood), or create no mandated energy costs (i.e., environmental legislation)
- no major changes in currency value or interest rates
- no technological breakthrough that would shift markets dramatically between sectors
- reasonable growth in both domestic and international markets
- no significant structural rationalization of industry
- past experience
- most capital investment will be directed toward increased production efficiencies and the environment. Little investment will be directed towards new capacity.
- over the period until at least the end of 1996, increases in production demand will range from less than 1 per cent (petroleum, pulp & paper) to over 2 per cent (plastics, vehicles and parts).

Canada's Industrial Economic Energy Efficiency Challenge: By Sector

The following status report for the major industrial energy using sectors for the years 1990, 1991 and 1992 identifies:

- the amount of energy used in terajoules
- the units output for each sector
- the energy efficiency rate (energy use divided by units of output), and
- the sector's energy efficiency index (a comparison based on 1990 equaling 100).

The objective is to show the energy efficiency performance of each sector from 1990 through 1992 and to present annual preliminary energy reduction targets per annum from 1995 to 2000

Pulp and Paper

The pulp and paper industry consumed 37.7 per cent of Canada's total industrial energy in 1992 and is Canada's largest industrial user of energy.

Biomass energy (pulp liquor, waste wood, etc.), however, constituted over 52.6 per cent of the energy consumed by this sector in 1992, 2.68 percentage points higher than it was in 1990.

Although biomass energy is more environmentally friendly, it is less efficient than carbon based energy.

Figure 7 compares total energy use, units of output, the sector's energy efficiency rate, and the overall energy efficiency index from 1990 through 1992.

Figure 7

Measure	1990	1991	1992
Total Energy Use (Terajoules)	806.16	818.26	824.3
Non biomass	402.63	428.15	433.76
Output (KT)	23.70	24.26	24.67
EE Rate	34.02	33.73	33.41
EE Index	100.0	99.15	98.23

Between 1990 and 1992, the pulp and paper industry's energy index (energy use divided by output, measured in kilo tonnes) fell by 1.77 per cent.

Preliminary Energy Efficiency Improvement Estimate

The pulp and paper sector's preliminary, energy efficiency estimate is 0.25 per cent per unit output per year for the period 1995 to 2000.

Petroleum Refining

Petroleum refining is Canada's second largest industrial user of energy, consuming 14.3 per cent of total industrial energy.

Figure 8 compares total energy use, units of output, the sector's energy efficiency rate, and the overall energy efficiency index from 1990 through 1992.

Figure 8

Measure	1990	1991	1992
Energy Use (Terajoules)	308.52	300.76	311.70
Output(CM)	101.35	98.18	96.33
EE Rate	3.044	3.063	3.236
EE Index	100.0	100.6	106.3

In essence, the petroleum refining energy index (energy use divided by output, measured in cubic metres) increased 6.3 per cent between 1990 and 1992.

Canada's Industrial Economic Energy Efficiency Challenge: By Sector

Preliminary Energy Efficiency Improvement Estimate

The petroleum refining sector's preliminary annual energy efficiency estimate for the period 1995 to 2000 is 0.8 per cent per unit of output.

Steel

The steel sector is Canada's third largest industrial user of energy, consuming 10.18 per cent of Canada's total industrial energy.

Figure 9 compares total energy use, units of output, the sector's energy efficiency rate, and the overall energy efficiency index from 1990 through 1992.

Figure 9

Measure	1990	1991	1992
Energy Use (Terajoules)	202.80	226.64	222.31
Output (KT)	11,343	11,113	12,038
EE Rate	.017879	.020394	.018467
EE Index	100.0	114.1	103.3

Steel's energy index (energy use divided by output, measured in kilo tonnes) increased by 3.3 per cent between 1990 and 1992.

Preliminary Energy Efficiency Improvement Estimate

The steel industry's preliminary energy efficiency annual estimate for the period 1995 to 2000 is 0.5 per cent per unit of output.

Aluminum and Non-Ferrous

The aluminum and non-ferrous sector is Canada's fourth largest industrial user of

energy, consuming 10.17 per cent of Canada's total industrial energy.

Figure 10 compares total energy use, units of output, the sector's energy efficiency rate, and the overall energy efficiency index from 1990 through 1992.

Figure 10

Measure	1990	1991	1992
Energy Use (Terajoules)	195.23	209.14	222.06
Output (KT)	1,821.6	1,971.8	2,280.0
EE Rate	.10710	.10607	.096739
EE Index	100.0	98.96	90.93

The aluminum and non-ferrous sector's energy index (energy use divided by output, measured in kilo tonnes) fell by 9.07 per cent between 1990 and 1992.

Preliminary Energy Efficiency Improvement Estimate

The aluminum and non-ferrous metal industry's preliminary energy efficiency annual estimate for the period 1995 to 2000 is not available. It will be set by a new Task Force in the coming months.

Chemicals

The chemical sector is Canada's fifth largest industrial user of energy, consuming 7.87 per cent of total industrial energy.

Figure 11 compares total energy use, units of output, the sector's energy efficiency rate, and the overall energy efficiency index from 1990 through 1992.

Figure 11

Measure	1990	1991	1992
Energy Use (Terajoules)	183.12	192.36	171.87

* Energy use for 1991, as well as outputs for this sector are being confirmed and will be published later.

Canada's Industrial Economic Energy Efficiency Challenge: By Sector

The chemical sector's energy index increased by 6.12 per cent between 1990 and 1992.

(The index is determined by dividing energy use by output. For the chemical industry, the output currently being used is a surrogate measured in constant 1986 dollars and is preliminary to identifying an industry unit of output.)

Preliminary Energy Efficiency
Improvement Estimate

See Canadian Chemical Producers' Association's publication "Reducing Emissions/ National Emissions Master Plan (NERM)".

Mining & Metallurgy

The mining & metallurgy is Canada's sixth largest industrial user of energy, consuming 5.4 per cent of Canada's total industrial energy.

Because transportation is an integral part of this industry, diesel and other transportation fuels are included in this sector's energy use data.

Figure 12 compares total energy use, units of output, the sector's energy efficiency rate, and its overall energy efficiency index.

Figure 12

Measure	1990	1991	1992
Energy Use (Terajoules)	139.31	133.12	118.96
Output (KT)	73,724	72,867	70,140
EE Rate	.001890	.001827	.001696
EE Index	100.0	96.7	89.7

The mining and metallurgy sector's energy index (energy use divided by

output, measured in kilo tonnes) fell by 10.3 per cent between 1990 and 1992.

Preliminary Energy Efficiency
Improvement Estimate

The mining and metallurgy industry's sector's preliminary annual energy efficiency estimate for the period 1995 to 2000 is 1.0 per cent per unit of output.

Wood Products

The wood products sector is Canada's seventh largest industrial user of energy, consuming 3.0 per cent of Canada's total industrial energy.

Figure 13 compares total energy use, units of output, the sector's energy efficiency rate, and the overall energy efficiency index from 1990 through 1992.

Figure 13

Measure	1990	1991	1992
Energy Use (Terajoules)	65.78	62.02	66.11
Output (1986 \$)	3,301	3,095	3,349
EE Rate	.019923	.020039	.019740
EE Index	100.0	100.6	99.1

The wood products sector's energy index fell by 0.9 per cent between 1990 and 1992.

(The index is determined by dividing energy use by output. For the wood products industry, the output currently being used is a surrogate measured in constant 1986 dollars and is preliminary to identifying an industry unit of output.)

Preliminary Energy Efficiency
Improvement Estimate

The wood products industry's preliminary energy efficiency annual

Canada's Industrial Economic Energy Efficiency Challenge: By Sector

estimate for the period 1995 to 2000 is 0.5 per cent per unit of output.

Cement/Lime

The cement and lime sector is Canada's eighth largest industrial user of energy, consuming 2.5 per cent of Canada's industrial energy.

Figure 14 compares total energy use, units of output, the sector's energy efficiency rate, and the overall energy efficiency index from 1990 through 1992.

Figure 14

Measure	1990	1991	1992
Energy Use (Terajoules)	64.49	54.69	54.48
Output (KT)	12,617.4	11,097.2	10,513.9
EE Rate	.005111	.004928	.005188
EE Index	100.0	96.4	101.4

The cement and lime sector's energy index (energy use divided by output, measured in kilo tonnes) increased by 1.4 per cent between 1990 and 1992.

Preliminary Energy Efficiency Improvement Estimate

The cement and lime industry's preliminary energy efficiency annual estimate for the period 1995 to 2000 is 0.7 per cent per unit of output.

Summary Energy Efficiency Improvement Estimates by Sector 1995 to 2000 and Avoided Energy

Preliminary annual energy efficiency estimates by sector are set out in Figure 15. It shows that the preliminary avoided energy for the period 1993 to 2000 is estimated to be approximately 100 Terajoules, assuming the energy efficiency improvement in 1993 and 1994 is the same as forecast for the period 1995 to 2000.

**Figure 15
Preliminary Industry Sector Annual Energy
Efficiency Improvement Estimates 1995-2000
and Preliminary Energy Avoided 1993 -
2000**

Industrial Sector	Annual % Energy Efficiency Improvement Targets 1995 - 2000	Total Energy Avoided in Terajoules 1993-2000
Pulp/Paper	0.25%	12.365
Petroleum	0.8%	14.962
Steel	0.5%	6.669
Chemicals	N/A**	N/A
Aluminum & Non-Ferrous	N/A***	N/A
Mining/ Metallurgy	1.0%	13.324
Wood Products	0.50	1.983
Cement/Lime	0.7%	2.288
Total 6 Sectors	0.48%	51.59
Other Sectors	1 to 2%*	17.275

* An estimate - StatsCan's ICE survey currently involves approximately 260 non-utility establishments. Accordingly, it is not possible to track and monitor energy consumed by small to medium sized companies.

The new ICE survey will include approximately 900 establishments. Even so, it will still not track the energy use of every SIC sector.

** See Canadian Chemical Producers' Association Annual Publication: "Reducing Emissions/National Emissions Master Plan (NERM)"

*** To be set by new Task Force within the next few months.

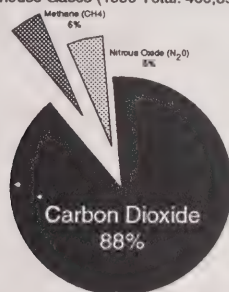
Canada's Carbon Dioxide Stabilization Challenge: The Rio Accord

In 1992, Canada committed to stabilize CO₂ emissions at 1990 levels by the year 2000, with the signing of the United Nations Framework Convention on Climate Change (the Rio Accord).

Canada contributes about 2 per cent of global CO₂ emissions. Carbon dioxide is by far the most significant greenhouse gas (GHG), representing 88 per cent of the total. See Figure 16.

Figure 16

Major Greenhouse Gases (1990 Total: 460,394 kt/Year)

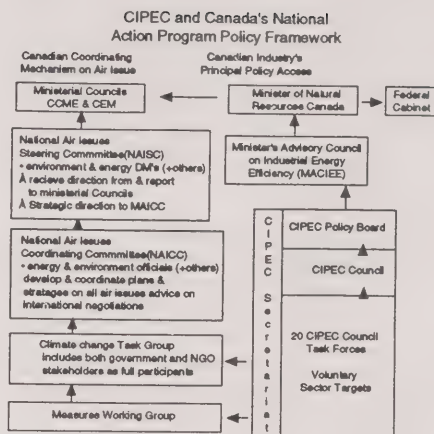


Canada's Carbon Dioxide Stabilization Challenge: National Action Program (NAP) on Climate Change

By signing of the Rio Accord, Canada agreed to prepare a National Action Program on Climate Change. (NAP)

The relationship of CIPEC to the process and the groups involved in developing Canada's NAP is illustrated in Figure 17.

Figure 17



CIPEC's participation in the development of the National Action Program (NAP) for Climate Change was through the Climate Change Task Group (CCTG) and its related Working Groups.

The CCTG is charged with developing options for stabilizing Greenhouse Gas Emissions (GHG) by 2000 for the National Action Program and options to reduce emissions beyond the year 2000.

The first iteration of the National Action Program is expected to be completed in the Fall of 1994 and tabled by Canada at a meeting in Berlin, Germany in March 1995.

CIPEC expects the NAP to be refined as more information becomes available.

Canadian industry, through the CIPEC Policy Board and MACIEE, provides the Minister of Natural Resources Canada with advice and counsel on industrial energy efficiency and climate change issues.

***Canada's Carbon Dioxide
Stabilization Challenge:
National Action Program
(NAP) on Climate Change***

The Climate Change Task Group has drafted a number of Foundation Measures and specific mitigation measures for:

- residential
- commercial
- industrial
- appliances and equipment
- transportation
- energy supply and production, and
- non-energy sources and sinks.

CIPEC has responded to the draft Climate Change Task Group's report, suggesting a number of important modifications.

Industry is committed to voluntarily reducing energy consumption per unit of production - economic energy efficiency.

In this way, industry is contributing to Canada's national target of stabilizing carbon dioxide emissions at 1990 levels by the year 2000.

***Canada's Carbon Dioxide
Stabilization Challenge:
Base Line Data***

In that carbon dioxide stabilization at 1990 levels by the year 2000 is an international goal, like energy efficiency, it is critical that broad agreement be reached on:

- the definition of industry
- the total and type of energy consumed by Canadian industry, by sector
- the reporting system to track the amount of energy used in each year, by industrial sector and by each region of the country
- the factors used to convert each type of energy into the amount of carbon dioxide released
- the economic and other assumptions used to forecast industrial energy use.

Unfortunately, an accurate carbon dioxide baseline data system is not yet available. Neither is there agreement on the assumptions for forecasting future industrial energy use.

CIPEC, working with CIEEDAC of Simon Fraser University, NRCan, StatsCan, and Environment Canada, is playing the lead role to establish such a system.

Progress is being made, but it will be mid-1995 at the earliest before an accurate energy use data collection system is in place. Additional work is urgently required on energy use forecasting.

Until then, it is inappropriate for government to make policy decisions based on current data.

Canada's Carbon Dioxide Challenge: Base Line Data

For purposes of calculating carbon dioxide emissions, industry is defined as manufacturing or mining industries producing carbon dioxide from stationary sources.

In 1990, of total CO₂ emissions, Canadian industry contributed 16.45 per cent, the transportation sector 32 per cent, electricity generation 20 per cent, the residential sector 9 per cent, industrial processes 6 per cent, the commercial sector 5 per cent, and other 11 per cent. See Figure 18.

Figure 18

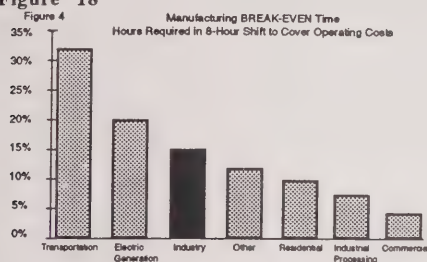


Figure 19 lists the principal industrial sources for CO₂ emissions in 1992 from stationary sources.

Five industrial sectors produced over 76 per cent of all industrial CO₂ emissions.

Figure 19

1992 Carbon dioxide Emissions by Sector

Rank	Industrial Sector	(000) Tonnes	% of Industry
1	Petroleum	17,064	24.22
2	Steel	14,879	21.12
3	Pulp & Paper	13,676	19.41
4	Aluminum/Non-Ferrous	4,405	6.25
5	Cement/Lime	3,530	5.01
	Sub Total	53,555	76.01
*	Other Sectors	16,903	23.99
	Total Industry	70,457	100.00

* Includes all other industrial sectors, including chemicals, wood products and aluminum/non-ferrous metals.

CO₂ is also released in certain industrial processes, however, these process released CO₂ emissions are not part of the definition of industry.

Likewise, Greenhouse Gas Emissions resulting from electricity production is not included in industry's total.

The national reporting system for CO₂ emissions segregates industrial emissions from CO₂ released by the production of electricity.

This is appropriate since industry cannot affect the decisions made by electrical utilities to use certain carbon based fuels.

However, some industry sectors are increasingly producing some or all of their electricity needs from co-generation, using natural gas. This reduces the volume of CO₂ emissions arising from their electricity use.

As a percentage of total Canadian CO₂ emissions, stationary industrial emissions declined to 14.98 per cent in 1992 from 15.49 per cent in 1990.

In 1990 industrial CO₂ emissions from stationary sources were 71.48 kilotonnes. This level steadily declined to 70.49 kilotonnes by the end of 1992, a decline of almost a million tonnes or 1.39 per cent.

Climate Stabilization: The Coming Challenge

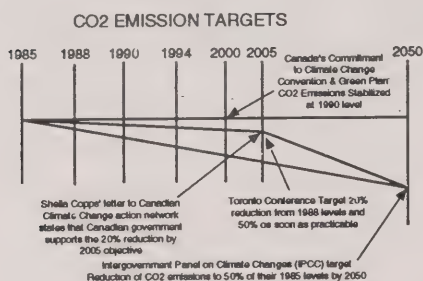
In addition to carbon dioxide stabilization, the United Nations Framework Convention on Climate Change (the Rio Accord) focused on stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. (climate stabilization).

While Canada has not committed to specific climate stabilization targets, the dimensions of the challenge are becoming clearer.

In 1990, the Intergovernmental Panel on Climate Change (IPCC) - a panel of scientists and policy makers from around the world - suggested that climate stabilization would require reducing carbon dioxide emissions to 50 per cent of their 1985 levels by 2050.

The federal Minister of the Environment is on record of favouring reducing carbon dioxide emissions 20 per cent from Canada's 1998 levels by the year 2005. See Figure 20.

Figure 20



The Rio Accord's climate stabilization goal, notwithstanding, the future of Canada's economy is a shared responsibility of industry and government, just as much as the ensuring of a healthy environment is a shared responsibility.

A stabilized climate in a stagnant, underachieving economy is not a realistic goal.

These are the kinds of issues which will need to be addressed by Canadians in the months and years ahead.

1994 International Industrial Energy Efficiency Conference

On April 29, 1994, CIPEC sponsored an important International Industrial Energy Efficiency Conference. Over 150 leading executives from Canadian industry attended.

The Minister of Natural Resources Canada, the Honourable Ann McLellan, outlined the federal government's expectation of industry in helping Canada meet its commitment to the Rio Accord.

Speakers from Europe, the United States and Canada dealt with issues across the industrial energy efficiency spectrum, including:

- a review of experiences of OECD countries which have adopted either the voluntary or regulatory approach to energy efficiency
- a discussion of how the United States is approaching energy efficiency/CO2 stabilization
- a insightful perspective from an environmentalist
- a description of Dupont Canada's energy efficiency initiatives
- an outline of the Danish industrial experience and involvement with a carbon tax

A highlight of the program was an audience discussion led by Duncan MacIntyre, President, National Quality Institute.

Ron Morrison, President, Kodak Canada Inc. and Chairman, CIPEC Policy Board outlined how CIPEC will discharge its mission to work with industry associations to help companies improve their energy efficiency through effective voluntary action.

Planning is currently underway to hold another International Industrial Energy Efficiency Conference in mid-1995.

The objective will be to bring together industry representatives from a number of OECD countries to report on their country's National Action Program on Climate Change and the implications which they see for industry in their country.

Canadian Industry's Voluntary Energy Efficiency Commitment: Some Examples

Between 1975 and 1992, Canadian industry reduced its energy use per unit of production, on a cumulative basis, by approximately 27.5 per cent. In other words, in 1992, Canadian industry used one quarter less energy to produce the same amount of goods.

Here are five examples of the continuing efforts being undertaken by industry to reduce its energy use:

The Steel Sector: Dofasco Inc. - \$750,000 Annual Electricity Savings

In 1993, the Hamilton steelmaker, Dofasco Inc., reduced its electrical energy bill by \$750,000 by paying attention to the good ideas of its employees.

"It sounds like easy money", says Steve Lounsbury of Dofasco's Electrical Energy Efficiency Team, "but it isn't. It requires tremendous effort by a number of different departments and, of course, the process teams that have to operate the mills.

"For example, from the No. 2 Hot Mill came the suggestion to reduce the mill to a creep from idle speed when there is no steel in the mill or there is sufficient time between pieces.

"Annual savings from that idea alone are estimated at \$300,000 a year. But the balance came from a lot of much smaller innovations".

***The Pulp and Paper Sector:
Kruger Inc. - \$337,000 Annual
Process Water Savings***

Last year, Kruger Inc.'s paperboard plant in Quebec won the Canadian Pulp and Paper Association's coveted Energy Conservation Opportunities Award.

The bright idea was to use 1,400 cubic meters of water daily, normally discharged as effluent, as sealing water for a paper machine's nine vacuum pumps.

The idea cost Kruger about \$60,000 to implement but it saves the plant \$337,000 each year.

***The Automotive Sector: Co-Ex-
Tec Industries: \$31,500 Annual
Electricity Savings***

Hissing noises are commonplace in plants using compressed air systems to run their processes.

But Steve Chan, Maintenance Manager of auto parts manufacturer Co-Ex-Tec Industries, Concord, Ontario found a few too many when he launched an audit last year.

Efficiency leapt skyward when the company combined its two separate systems into one (eliminating the need for one of four, 150 hp compressors), repaired air leaks and installed air flow controls. These relatively simple improvements produced annual energy savings of about 630,000 KwH or \$31,500.

Canadian Industry's Voluntary Energy Efficiency Commitment: Some Examples

The Automotive Sector: General Motors of Canada - Annual Electricity Savings of \$6,265,321

Since 1990, G.M. of Canada has reduced its non-production electricity load by 20 per cent or 6,500 kilowatts for total savings of \$6,265,321. This has avoided carbon dioxide emissions by 45 million kilograms.

G.M.'s Woodstock National Parts Distribution Centre is the most recently completed project. In this 1 million square foot facility, the interior and exterior lighting systems were replaced with efficient high pressure sodium lighting.

The result is impressive. Lighting levels increased by 200 per cent, resulting in a better quality workplace, while the lighting load was reduced from 1,940 kw to 735 kw (a 1205 kw reduction).

The project cost \$1.2 million, but saves \$0.54 million annually..

The Mining Sector: Falconbridge Limited

Between 1990 and 1993, Falconbridge reduced its electrical energy requirements by 3.5 per cent at its Timmins and Sudbury operations.

This reduction was achieved by employee Energy Teams, using with a mixture of capital and non capital techniques. Production levels or economic efficiencies did not suffer during this period.

Three of the world's most efficient zinc refineries are located in Canada - in British Columbia (Cominco), Quebec

(Noranda-CEZ) and Ontario (Falconbridge Kidd Creek Division).

Inco Sudbury is the most nickel efficient producer in the world.

This typifies the energy management commitment of Canada's mining industry.

Appendix 1

Manufacturing and Mining Standard Industrial Classification Codes (SIC)

CIPEC has expended a great deal of effort to develop accurate, credible base line data on industrial energy use.

With the cooperation of Statistics Canada, Natural Resources Canada, Environment Canada, the Canadian Industry Energy End-Use Database and Analysis Centre of Simon Fraser University, and various industrial and mining associations, a data collection and analysis system is being developed. For the period 1990 to 1992, however, it has been necessary to construct energy consumption data by sector.

CIPEC is approaching the data issue in three phases by standard industrial code (SIC). This Annual Report deals with the industrial establishments identified in the SIC codes listed in phase 1 of Figure 21 below. Phase 1 covers industrial establishments using over 91 per cent of all industrial energy. Sectors in Phases 2 and 3 will be examined in the coming months.

Figure 21

Industry Sector	CIPEC Phase 1	CIPEC Phase 2 -	CIPEC Phase 3
Pulp & Paper	2711, 2712, 2713, 2714, 2719		
Petroleum Refining	3611		
Chemicals	3711, 3612, 3721, 3731		
Mining, Metallurgy	0611, 0612, 0613, 0614, 0615, 0616, 0617, 0619, 0621, 0623, 0624, 0625, 0629	0631, 0632, 0633	
Steel	2919	2941	
Aluminum & Other Primary Metals	2951, 2958	2961	
Cement & Lime	3521, 3581	3561	
Wood Products	2512, 2522, 2592		
Transportation, Motor Vehicles & Parts		3231, 3251, 3254, 3255, 3256, 3259	3211, 3261, 3271
Plastics	-	1611, 1621, 1631, 1691	
Textiles	-	1811, 1829, 1921, 1992,	
Food Processing, Bakeries & Grocery Products	-	1011, 1012, 1121, 1031, 1032, 1041, 1049, 1053, 1071, 1072, 1083, 1099	
General Manufacturing	-	1511, 1521, 2819, 2841, 3042, 3049, 3081, 3111 3041,	1511, 1521
Electrical/ Electronics	-	3311, 3351, 3352, 3381,	
Beverage	-	1111, 1121, 1131	

Appendix 2

Letters of Cooperation (LOC's)

CIPEC has entered into Letters of Cooperation (LOCs) with 13 associations.

The associations are:

- Aluminum Industry Association
- Automotive Parts Manufacturing Association

- Canadian Chemical Producers' Association
- Canadian Gas Association
- Canadian Manufacturers' Association
- Canadian Petroleum Products Institute
- Canadian Plastics Institute
- Canadian Steel Environmental Association
- Canadian Textile Institute
- Cement Council of Canada
- Electrical & Electronic Manufacturers Association
- Mining Association of Canada
- Motor Vehicle Manufacturers Association

Other LOCs are in process.

Sample Letter of Cooperation

The following is a sample letter of cooperation entered into between CIPEC and an Association.

"By this letter of cooperation, (LOC), the Association in collaboration with CIPEC, undertakes to encourage its member companies to develop and implement plans for energy efficiency as a means of becoming more competitive, thereby participating in helping to meet Canada's carbon dioxide emission stabilization goals.

The Association will work with its member companies to:

1. Appoint a CEO to the CIPEC Policy Board.
2. Establish an industry sector Task Force within CIPEC to develop sector targets and to develop plans to continually improve energy efficiency in relation to such targets.
3. Provide input to reports and studies prepared by or for CIPEC or government on sector energy efficiency improvement performance or potential.
4. Identify industry sector opportunities for the promotion of industrial energy efficiency, including training and technology.
5. Distribute CIPEC material supporting energy efficiency, as appropriate.

CIPEC will provide:

1. Sector data on energy efficiency and/or other criteria mutually agreed upon by the sector Task Force and CIPEC.
2. Administrative support to the Task Force in response to its needs.
3. Public recognition of participation in CIPEC for leadership in improving energy efficiency.
4. Access to CIPEC support service, including Training, On-Site Human Resources, Sector Studies, Performance Contracting, Technology Development, and Task Force Marketing.
5. Promotion of the progress of industry-at-large in meeting the goals of CIPEC and Canada in terms of improving energy efficiency and helping to meet Canada's carbon dioxide emissions stabilization

6. Support research activity aimed at goals.
improving the efficient use of energy.
6. Communication linkages with
governmental agencies and other related
associations on energy efficiency matters.

Further, both parties recognize that: a) this voluntary agreement may be terminated at any time by either party, and b) as a participant, the Association shall be entitled to use the logo and other intellectual property of CIPEC in its promotion of industrial energy efficiency.

Accepted and agreed to this _____ day of _____, 1994

Ron Morrison, Chair
Policy Board, CIPEC

Association Chair

CIPEC

For More Information about CIPEC and
its activities, write, fax or call:

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CIPEC

CIPEC

*Canadian Industry Program
for Energy Conservation*

Industrial Competitiveness through Energy Efficiency

1994 - 1995

Annual Report



CIPEC

December 15, 1995

The Honorable A. Anne McLellan
Minister of Natural Resources
Ottawa, Ontario K1A 0A6

Dear Minister

I am pleased to enclose CIPEC's 1994-1995 Annual Report.

This report provides clear, credible proof that, within the manufacturing and mining sectors, the voluntary approach to the Climate Change Challenge is working. More particularly, the report demonstrates that Canadian industry is making a strong contribution to stabilizing carbon dioxide emissions at 1990 levels by 2000.

I look forward to discussing our annual report with you and to exploring how we can build on our working relationship in the years ahead.

Yours sincerely,

Charles H. Hantho
Chairman, CIPEC Policy Board



CIPEC

Highlights

Manufacturing and mining (industry) companies continued to make significant improvements in energy efficiency per unit of production and carbon dioxide emissions from stationary sources in 1994-1995, including:

- 178 companies, representing more than 65 per cent of all industrial energy use, qualified as Industrial Energy Innovators
- target setting by individual industrial sectors has confirmed the 1994 commitment to improve industrial energy efficiency per unit of production by one per cent a year from 1995 to 2000 - an integral part of industry's undertaking to stabilize carbon dioxide emissions at 1990 levels by 2000
- substantial fuel substitution and/or energy efficiency gains have been achieved by most of the major industrial energy using sectors
- two new industrial sector task forces have been established. In total, there are now 14 in place. As a result, there is now greater focus of effort, better verification of industry data, and encouragement of related sector companies to broaden their commitment
- Letters of Cooperation (LOC) have been signed with 15 major industrial trade associations and four individual companies in the food and beverage sectors
- Statistic Canada's (StatsCan) Industrial Consumption of Energy (ICE) Survey has been revised and enhanced to more than double the sample size, thereby increasing its accuracy
- industry's share of total Canadian energy use fell 1.25 percentage points between 1990 and 1994, even though industrial Gross Domestic Product (GDP) grew by 4.8 per cent over the same period
- industrial energy consumption between 1990 and 1994 grew only 3.1 per cent while total Canadian energy consumption grew by 9.2 per cent
- industrial energy intensity (industrial energy use divided by industrial GDP) fell by 0.3 per cent between 1990 and 1994
- industrial carbon dioxide intensity (carbon dioxide emissions divided by industrial GDP) fell by 5.9 per cent since 1990, an average of 1.5 per cent a year
- in 1994, carbon dioxide emissions were 1.4 per cent, or 1,350 kilotonnes of carbon dioxide, below 1990 levels, primarily because of improved energy efficiency, fuel switching from coal to natural gas and to biomass. By contrast, overall, Canada's carbon dioxide emissions increased by 4.7 per cent over this period
- confirmation that industry can achieve 1990 levels of carbon dioxide emissions by the year 2000, assuming industrial GDP grows at or below 2 per cent a year between 1995 and 2000
- in 1994, seven industrial sectors, as a group, exported 1,133 petajoules of embodied energy and 22,100 kilotonnes of related embodied carbon dioxide emissions.



Table of Contents

Chairman's Letter and Highlights	1
Definitions	4
Executive Overview	5
Canadian Industry Program for Energy Conservation	9
• Mission	9
• Structure	10
• Policy Board	10
• Sector Task Force Council	11
Industry's Energy Efficiency Performance: 1990 to 1994	12
• Recording Industry's Progress	13
• Total Canadian Energy Consumption	14
• CIPEC Universe of Companies	14
• Economic Growth	15
Energy Efficiency by Sector: 1990 to 1994	16
• Tier 1 "Base" Sectors	18
• Pulp & Paper	20
• Petroleum Refining	23
• Steel	26
• Non-Ferrous Smelting and Refining	30
• Chemicals	33
• Metal Mining	34
• Cement	36
• Tier 1 "New Reporting" Sectors	38
• Oil Sands/Upgrader	39
• Non Metal Mining	41
• Glass	42
• Tier 2 And All Other Sectors	43
• Brewery Products	44
• Textiles	46
• Transportation (Manufacturing)	48



CIPEC

Table of Contents

Exports of Embodied Energy: 1994	50
Energy Efficiency Commitment: 1995 to 2000	51
Carbon Dioxide and Other Greenhouse Gas Emissions	52
Industry's Carbon Dioxide Emissions Performance: 1990 to 1994	53
Exports of Embodied Carbon Dioxide	54
Climate Stabilization: Post 2000	55
Projecting the Carbon Dioxide Emissions Gap: Post 2000	56
CIPEC Services to Industry	61
• Benefits to Companies	62
• Benefits to Associations	62
• Group ISO 9000 Program for SME's: Energy Efficiency Performance Measures	63
1995 International Energy Efficiency Conference	65

Appendices

1. CIPEC Industrial Sectors - Standard Industrial Classification (SIC) Codes	69
2. Industrial Consumption of Energy (ICE) Survey Form	77
3. Industrial Energy Innovators - By Sector	78
4. Recording Industry's Progress	81
5. Sample Letter of Cooperation	84

Industry

Industry is defined as those companies in the manufacturing and mining sectors.

Industrial Energy,

Industrial energy is energy used in stationary sources to produce manufactured and mined products, including:

- purchased and non-purchased fuels - net electricity, natural gas, coal, liquid natural gas, steam, coke, coke oven gas, all petroleum products (light fuel oil, and kerosene), (heavy fuel oil, diesel fuel oil, petroleum coke and still gas)
- petroleum refining own use of refined petroleum products
- biomass fuel (pulping liquor and wood waste). See Appendices 1 and 2.

Total Canadian Energy Demand

Includes:

- the energy demand of the residential, transportation, commercial and industrial sectors
- non-energy use (feedstocks, asphalt, lubricants and greases, etc.)
- own use (refined petroleum products (RPP's), electricity, gas pipeline, coal, natural gas liquids, etc.)
- conversion losses in electricity generation, steam generation, etc.

Total Canadian Carbon Dioxide Emissions

Includes carbon dioxide emissions associated with:

- the consumption of all fuels in each sector (industrial, residential, commercial and transportation);
- power generation and steam generation;
- non-energy use;
- all own-use.

Total Industrial Carbon Dioxide Emissions

Includes carbon dioxide emissions associated with

- the combustion of all fuels listed in total industrial energy definition above except for electricity which is entirely allocated to utilities and biomass
- petroleum refining's own consumption of RPP's as described above

Industrial Sector Energy Efficiency

Energy use of companies in an industrial sector divided by units of production chosen by that sector to measure its performance.

Industrial Sector Energy Intensity

Energy use of companies in an industrial sector divided by value of production in that sector expressed in 1986 dollars.

Base Year

1990 is the base year from which the energy efficiency or energy intensity performance of industrial companies is measured for the period 1991 through 1994.

Calculation of the Ten Year Period 1990 to 2000

The ten year period - 1990 to 2000 - is calculated from January 1, 1991 to December 31, 2000.

Industrial Gross Domestic Product (GDP)

Industrial GDP is defined as the output of manufacturing and mining industries.



Executive Overview

CIPEC - Since 1975

CIPEC is a voluntary initiative of Canada's manufacturing and mining industries.

Created in 1975, participating companies reduced their energy use by over 26.2 per cent per unit of production between 1975 and 1990, for an annual on-going reduction of 30 megatonnes of carbon dioxide.

In 1992 CIPEC refocused in response to Canada signing the United Nations Framework Convention on Climate Change - the Rio Accord. More than 150 countries agreed to stabilize greenhouse gas emissions at 1990 levels by the year 2000 as a result of the Accord.

Through supporting industry associations, 3,000 companies are now involved in CIPEC, up from 700 during the 1975 to 1990 period. In 1994, industry contributed well over \$1.5 million in time and effort involved in establishing industry sector energy efficiency targets, in reporting on their energy efficiency performance and in encouraging other companies to give priority to industrial energy efficiency. This is in addition to the millions of dollars industry invested in energy efficiency improvements.

The performance data contained in this report results from the combined efforts of CIPEC and its Sector Task Forces, StatsCan, NRCan and the Canadian Industrial Energy End-Use Data and Analysis Centre (CIEEDAC) operating out of Simon Fraser University, British Columbia.

In 1994, to increase the quality, reliability and suitability of the data, at the request of CIPEC and NRCan, StatsCan revised its Industrial Consumption of Energy (ICE) Survey. More than 700 industrial establishments, accounting for about 78 per cent of Canada's industrial energy use, were surveyed. The focus in this report is on the major industrial energy using sectors.

The number of industrial establishments included in the 1995 ICE survey will rise to almost 2,000, increasing its accuracy and scope.

Canadian Industrial Energy Consumption: 1990 - 1994

Canada's total energy consumption rose 9.2 per cent between 1990 and 1994, from 9,082 to 9,918 petajoules.

Industrial energy use increased 3.1 per cent between 1990 and 1994, from 2,598 to 2,679 petajoules. See Appendix 1.

Industrial GDP grew by 6.5 per cent in 1994 (in constant 1986 dollars), but the cumulative GDP growth over the period 1990 to 1994 was only 4.8 per cent, resulting in average annual growth of 1.2 per cent for the period.

Industry's share of total Canadian energy use fell 1.25 percentage points between 1990 and 1994.

Industrial Energy Performance: 1990 - 1994

Industrial energy intensity (industrial energy use divided by industrial GDP) improved slightly by 0.3 per cent.

Energy Consumption by Industry Sector: 1994

Seven sectors - pulp and paper, petroleum refining (petroleum products), smelting and refining, steel, chemicals, metal mining and cement - consumed just over 69 per cent of all the energy used by industrial companies in 1994. Between 1990 and 1994, energy consumption in these sectors increased by 1.6 per cent.

Three sectors - oilsands/upgrader, non-metal mining and glass - consumed another 9.0 per cent of total industrial energy. All other industrial sectors consumed the remaining 21 per cent.

Energy Efficiency by Industry Sector: 1990 - 1994

Of 10 industrial sectors for which energy efficiency information is available for the period 1990 to 1994, nine sectors demonstrate significant to moderate energy efficiency or energy intensity improvement.

It is expected that energy efficiency performance measures will be available for most industrial sectors for inclusion in the 1995/96 Annual Report.

Industrial Energy Innovator Initiative

178 companies, representing 65 percent of total industrial energy use, have become Industrial Energy Innovators and, as such, have committed to:

- implement energy efficiency measures that make good economic sense;
- review their energy efficiency performance annually; and
- furnish CIPEC with a brief annual review of their successes and/or achievements and, where possible, a copy of their action plans and specific energy efficiency improvement goals.

If requested, these companies were automatically registered as Industrial Energy Innovators in the Voluntary Challenge Registry (VCR). See Appendix 3 for a list of the Industrial Energy Innovators in each industry sector.

Industry Energy Efficiency Commitment: 1995 - 2000

14 industry sectors have established annual energy efficiency improvement targets for the period 1995 to 2000. They represent an aggregate total industry reduction in energy use per unit of production of one per cent each year over the period.

Exports of Embodied Energy: 1994

Canada is a major exporter of processed and semi processed natural resources. In 1994 seven of the largest industrial energy using sectors - petroleum refining, pulp and paper, steel, smelting and refining, chemicals, mining and cement - exported 1,133 petajoules of energy, or 61 per cent of their total energy consumption, in the form of embodied energy.

Canadian Carbon Dioxide Emissions: 1990 - 1994

Canada's total carbon dioxide emissions rose 4.7 per cent between 1990 and 1994, from 460,452 to 481,948 kilotonnes, an increase of 21,496 kilotonnes.

Industry's Share of Total Canadian Carbon Dioxide Emissions: 1990 - 1994

Canadian industry is now emitting 1.46 per cent less carbon dioxide than it did in 1990, even though, during the same period, industrial GDP grew by 4.8 per cent. This is primarily because of improved energy efficiency, fuel switching from coal (primarily to natural gas) and to biomass.

Industry's share of total Canadian carbon dioxide emissions has declined from 20.1 per cent in 1990 to 18.9 per cent in 1994.

Actual Carbon Dioxide and Projected Emissions to 2000: 1990 - 1994

If the 1990 to 1994 average annual decline in carbon dioxide intensity of 1.5 per cent is maintained between 1995 and 2000, and if the annual industrial GDP growth rate does not exceed 2 per cent, industry's carbon dioxide emissions in 2000 will exceed 1990 levels by only 1.6 per cent. CIPEC continues to believe, however, that with increased effort, industry will be successful in meeting its 1994 stabilization commitment.

Exports of Embodied Carbon dioxide Emissions: 1994

In 1994, seven industrial sectors exported over 42 per cent of the embodied carbon dioxide emissions contained in the products they sold abroad. This totaled some 22,100 kilotonnes of carbon dioxide.

Economic Greenhouse Emission Gas Emission Targets: Post 2000

The 1995 Berlin "Conference of Parties" established a process to negotiate new greenhouse gas emission targets for 2005, 2010, and 2020.

To begin to understand the impact which post-2000 greenhouse gas emission reductions might have on Canada, a study was undertaken to identify the potential "gap" between anticipated carbon dioxide emissions and four proposed targets:

- a 20 per cent reduction in carbon dioxide emissions from 1988 levels by 2005 (Toronto Conference)
- a 20 per cent reduction in carbon dioxide emissions from 1990 levels by 2005 (Alliance of Small Island States - AOSIS)
- a 10 per cent reduction from 1990 greenhouse gas emissions by 2010 (United Kingdom)
- the maintenance of 1990 greenhouse gas emission levels beyond 2000 (European Union)

The major findings of the study suggest that:

- achievement of carbon dioxide or total GHG emission targets below 1990 levels will require, either:
 - significantly lower annual Canadian industrial GDP growth rates, with attendant unemployment, increased government debt, and/or reduced government spending, or
 - compensating reductions in carbon dioxide emissions by other sectors of the economy: residential, transportation, commercial, agriculture, etc.
- three of the four proposed targets for reduced greenhouse gas emissions beyond 2000 can be achieved only if Canada experiences negative industrial GDP growth.
- the fourth target (i.e., European Union) can be achieved only with an annual industrial GDP growth rate of less than 1 per cent, assuming an annual industrial carbon dioxide intensity of 0.7 per cent for the period beyond 2000.

In view of the above, it becomes apparent that greenhouse gas emission targets are as much an economic, trade, jobs, standard of living, issue as it is an environmental issue. As such, Canada cannot afford to treat these international GHG negotiations lightly or as a single item agenda.

1994 / 1995 in Review

1994

October: Industry makes a preliminary commitment to the Minister of Natural Resources Canada to reduce its energy use per unit of production by 1 per cent a year from 1995 to 2000 and to have carbon dioxide emissions at 1990 levels by the year 2000, assuming the continuation of carbon dioxide emission reductions achieved from 1990 to 1992, and average industrial economic growth does not exceed 2 per cent a year.

November: Federal/Provincial Energy and Environment Ministers review a draft National Action Program on Climate Change.

December: StatsCan inaugurates a revised ICE Survey designed to more accurately measure the energy use of Canadian industry.

1995

February: Federal/Provincial Energy and Environment Ministers approve Canada's National Action Program on Climate Change.

March / April: Canada's National Action Program on Climate Change released.

Conference of Parties (COP 1), Berlin, Germany reviewed progress since the 1992 Rio Accord and confirmed that performance to date is inadequate to meet the long term goals of the Accord. It established a process to negotiate reduction targets and timetables beyond the year 2000. Such targets would apply only to developed countries.

April to September: CIPEC Sector Task Forces review and confirm energy efficiency targets between 1995 and 2000.

August: Canada's Climate Change Voluntary Challenge and Registry (VCR) Participant's Handbook released and VCR launched.

1994 ICE Survey results available to CIEEDAC for further analysis.

September: Industrial Energy Innovator (IEI) Initiative inaugurated.

A Study is initiated to assess the potential industrial carbon dioxide emission gaps in the years 2005 and 2010 as measured against four proposed emission targets.

October: Environment Canada confirms that Canada's industrial companies produced 1.46 per cent less carbon dioxide emissions in 1994 than they did in 1990, a reduction of 1,350 kilo tonnes.

November: 178 companies, accounting for more than 65 per cent of industrial energy consumption, commit to become Industrial Energy Innovators and to be registered as such in the VCR.

Industry, at the November 9th MACIEE meeting, (Minister's Advisory Council on Industrial Energy Efficiency) confirms its 1 per cent per year energy efficiency target to 2000 and its ability to achieve carbon dioxide emission stabilization at 1990 levels by 2000.

CIPEC sponsors its 2nd International Energy Efficiency Conference.



Canadian Industry Program for Energy Conservation

Created in 1975, when energy security and high energy prices were major concerns, CIPEC is a voluntary initiative of Canada's manufacturing and mining companies. It is supported by government, energy utilities and industry associations, and promotes and monitors energy efficiency throughout Canadian industry.

From 1975 to 1990, Canadian industrial companies voluntarily reduced energy consumption per unit of production by over 26.2 per cent, an average annual reduction of 1.6 per cent. This is equivalent to 30 million tonnes of carbon dioxide emissions avoided per year.

In 1992, CIPEC refocused in response to Canada signing the Rio Accord and its commitment to stabilize carbon dioxide emissions at 1990 levels by the year 2000.

Today, energy efficiency, global competitiveness and the need to contribute to stabilizing energy related carbon dioxide emissions are key motivating forces for industry's voluntary efforts to reduce its energy consumption per unit of production.

Through supporting associations, 3,000 companies are now involved in CIPEC energy efficiency activities, up from 700 during the 1975 to 1990 period. CIPEC is a single, major voice for Canadian industry on energy efficiency.

In 1994, industry contributed well over \$1.5 million in time and effort determining industry sector targets, reporting on their energy efficiency performance and encouraging other companies to become engaged. This is in addition to the millions of dollars industry invested in energy efficiency improvements.

CIPEC is governed by an 18 member Policy Board, most members of which also advise the Minister of Natural Resources Canada through participation in the Minister's Advisory Council on Industrial Energy Efficiency (MACIEE).

Industry's voluntary energy efficiency initiatives are coordinated by a 21 member Task Force Council. CIPEC's Policy Board and Task Force Council are supported by a small Secretariat.

CIPEC's Mission

To promote effective voluntary action which enhances industrial energy efficiency and economic performance while participating in meeting Canada's carbon dioxide stabilization objectives.

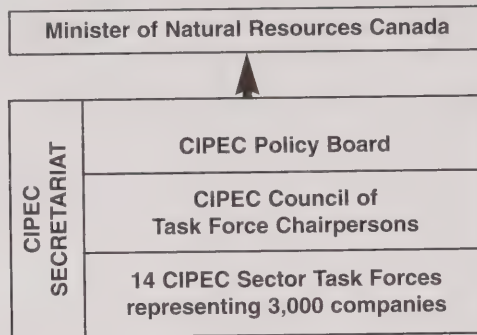


Canadian Industry Program for Energy Conservation

CIPEC Structure

Figure 1 illustrates CIPEC's organizational structure.

Figure 1



CIPEC Policy Board

CIPEC's governing body is its Policy Board with representation from 18 industrial sectors. The Board sets CIPEC's overall policy direction which is carried out by the sector Task Forces, Council of Task Force Chairpersons and the CIPEC Secretariat. It monitors progress and accomplishments and meets about four times a year.

The Minister of Natural Resources Canada draws extensively from the CIPEC Policy Board for the membership of the Minister's Advisory Council on Industrial Energy Efficiency (MACIEE).

Policy Board Membership

CIPEC's Policy Board includes:

Chairman:

Chuck Hantho, *Dominion Textile Inc. and Dofasco Inc.*

Members:

Claude Chamberland, *Alcan Aluminum Limited*

Bob Renaud, *Chrysler Canada*

Peter Rankine, *Honeywell Limited*

Emmie Leung, *International Paper Industries Ltd.*

Ron Morrison, *Kodak Canada Inc.*

Frank Pickard, *Falconbridge Ltd.*

John D. Redfern, *Lafarge Canada Ltd.*

Stephen Van Houten,
Canadian Manufacturers' Association

Peter Torbet, *Chairman, CIPEC Task Force Council*

Arthur Sawchuk, *Dupont Canada Inc.*

Robert Schad, *Husky Injection Molding Systems Ltd.*

Brenda Schiedel, *Coyle & Greer Awards Canada*

Fred Telmer, *Stelco Inc.*

Ron Munkley, *Consumers' Gas Company*

George Weyerhaeuser, Jr., *Weyerhaeuser Canada Ltd.*

Charles Wilson, *Shell Canada Ltd.*

Michael O'Brien, *Sunoco Group, Suncor Inc.*

Bent Larsen, *Executive Director, CIPEC*



Canadian Industry Program for Energy Conservation

CIPEC Sector Task Force Council

Since 1975, major industrial sectors have been represented on the CIPEC Council. This Council is composed of the Chairperson of each Sector Task Force and meets 6 to 8 times a year. There are now 14 Sector Task Forces.

Between Council meetings, Sector Task Forces meet to set sector energy efficiency targets, review progress and to identify the energy efficiency needs particular to their sector.

The interests of approximately 3,000 companies are represented on the CIPEC Sector Task Force Council. In addition, there is a sharing of views with the natural gas and electric utilities and government through representatives from these sectors participating in the Council's activities as associate members.

Task Force Council Membership

Chairman:

Peter Torbet, *3M Canada*

Executive Director:

Bent Larsen

Sectors and Members:

Aluminum

Christien Van Houtte, *Aluminum Industry Association*

Brewery

Ralph Backman, *Labatt Breweries of Canada*

Electrical and Electronic

Steve Horvath, *Honeywell Ltd.*

Food Processing

John Corey, *McCain Foods Limited*

Steel

Susan Olynyk, *Dofasco Inc.*

General Manufacturing

Peter Notzl, *Canadian Manufacturers' Association*

Cement

John M. Lind, *St. Mary's Cement Company*

Mining

John Owen, *Falconbridge Limited*

Petroleum Refining

Bob Clapp, *Canadian Petroleum Products Institute*

Plastics

Don Clarke, *Canadian Plastics Institute*

Pulp and Paper

Norman Pridham, *Quono Corporation*

Textiles

Peter Chantraine, *Dupont Canada Inc.*

Transportation

Ken Rossi, *Ford Motor Company of Canada*

Wood Products

Dick Bryan, *Council of Forest Industries*

Collaborators:

Chemical

Bruce Caswell,

Canadian Chemical Producers Association

Utilities

William Hale, *Ontario Hydro, (Canadian Electricity Association)*

Michael Stedman, *Centra Gas (Canadian Gas Association)*

Government

Linda Ploeger,

Ontario Ministry of Environment and Energy

Richard McKenzie, *Natural Resources Canada*

Recording Industry's Progress

Industry's energy efficiency and carbon dioxide emission reduction progress is recorded in five main ways:

- through StatsCan surveys which collect energy consumption data from industrial companies.

This data is used:

- by Simon Fraser University's Canadian Industrial Energy End-Use Data and Analysis Centre (CIEEDAC) to analyze and compare year to year industrial energy consumption data, and from which are developed energy efficiency and energy intensity data
 - by CIPEC, its Sector Task Forces and associated trade associations, to build the industrial energy use data base and to monitor progress in relation to established targets
 - by Environment Canada to build the National Inventory of Greenhouse Gas Emissions
- by the Climate Change Voluntary Challenge and Registry (VCR) when it records individual company action plans. See Appendix 4.

Energy Use Data Collection and Analysis

CIPEC, over the past four years, has worked with industry associations, StatsCan, Natural Resources Canada (NRCan), and CIEEDAC to build the database and monitor industrial energy use since the 1990 base year. This has resulted in a mutually agreed upon data collection and analysis procedure.

StatsCan has historically recorded the consumption of energy from two separate sources. These are:

- Industrial Consumption of Energy (ICE) survey, which contributes information published in the Quarterly Report of Energy Supply and Demand (QRES), and
- Consumption of Purchased Fuels and Electricity (CPFE) report, which forms part of the Annual Survey of Manufacturers (ASM).

Both reports have characteristics which make neither suitable as a monitoring device for energy consumption in specific industries.

To increase the quality, timeliness, reliability and suitability of the data reflecting energy consumption in specific industries, changes were made in 1994 to StatsCan's ICE survey. Appendix 3 illustrates the kind of information now requested by this survey. Information obtained by the new ICE survey has led to some changes in historical calculations.

Approximately 730 establishments, representing over 78 per cent of total industrial energy consumption, now report to StatsCan on their energy use. This information is also used to calculate the amount of carbon dioxide emissions which industry produces from stationary sources.



CIPEC

Energy Efficiency Performance: 1990 to 1994

Recording Industry's Progress

Data for the 1995 ICE Survey will be collected from almost 2,000 companies, resulting in a significant increase in the scope of the survey, involving many more industry sectors and the ability to produce provincial or regional data. In addition, the survey is being customized for the steel and petroleum refining sectors to provide additional data on non-purchased fuel. The pulp and paper sector will use the generic ICE survey form but with modified guidelines.

Carbon Dioxide Emissions Data Collection and Analysis

In that Canada has committed to stabilize greenhouse gases at 1990 levels by the year 2000, it is critical that broad agreement be reached on:

- the definition of industry
- the total and type of energy consumed by Canadian industry, by sector
- the reporting system to track the amount of energy used in each year, by industrial sector and by each region of the country
- the factors used to convert each type of energy into the amount of carbon dioxide released
- the economic and other assumptions used to forecast industrial energy use, and
- the reporting system used to track the release by industry of greenhouse gases other than carbon dioxide.

Unfortunately, an accurate carbon dioxide and other greenhouse gas baseline data system is not yet available. Neither is there agreement on the assumptions for forecasting future industrial energy use.

Environment Canada is responsible for calculating the associated carbon dioxide and other energy related greenhouse gas emission estimates for the CIPEC defined universe as a subset of the total national greenhouse gas emissions inventory.

StatsCan and Environment Canada have signed a Memorandum of Understanding on Data Sharing, providing Environment Canada with full access to all energy data now gathered by StatsCan starting in calendar year 1996 and beyond, thus enabling further disaggregation of emissions.

Energy Efficiency

Energy efficiency is measured in a variety of ways. One widely used measure for international comparison purposes is energy use per capita. Another is energy use as a ratio of Gross Domestic Product (GDP). Neither, unfortunately reflects CIPEC's focus - improving the effectiveness / efficiency of energy use. Both international comparisons have serious flaws, including not accounting for the export of energy intensive products and related carbon dioxide emissions.

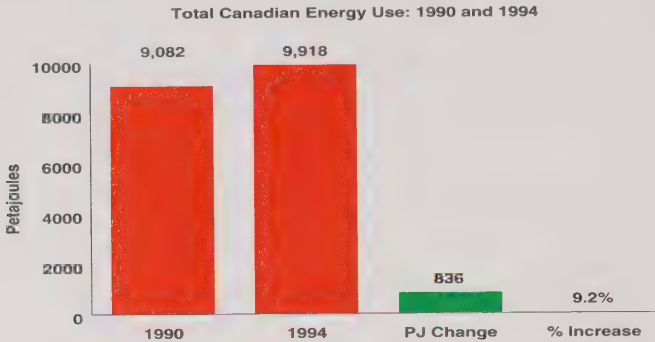
An alternative and more appropriate measure is the amount of energy needed to produce a unit of production. CIPEC primarily uses this measure to track the progress of Canadian industry.

CIPEC takes the position that, given the high energy efficiency of many of Canada's industrial sectors, less greenhouse gas emissions will result worldwide from more production in Canada than in other less energy efficient countries.

Total Canadian Energy Consumption

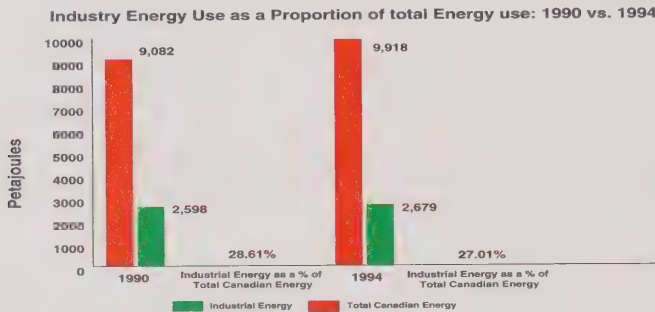
Canada consumes over 9,000 petajoules of energy each year. Between 1990 and 1994, its energy consumption increased by 9.2 per cent, or 836 petajoules, from 9,082 to 9,918 petajoules.

Figure 2



In 1994, industry consumed 27 per cent of total Canadian energy use, down from 28.6 per cent in 1990.

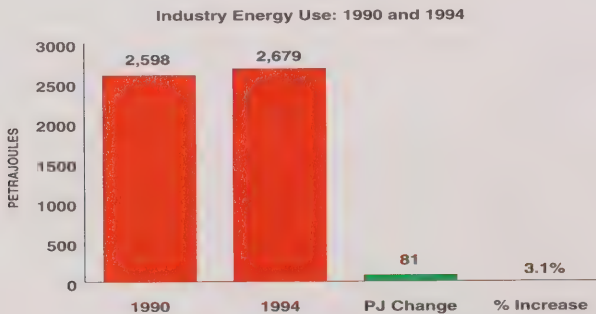
Figure 3



CIPEC Universe of Companies

The CIPEC universe of companies includes most of StatsCan's definition of the manufacturing and mining companies. See Appendix 1 for a list of the SIC codes for those sectors covered. Between 1990 and 1994, these companies increased their energy consumption by 81,000 terajoules, or 3.1 per cent.

Figure 4





CIPEC

Energy Efficiency Performance: 1990 to 1994

Economic Growth

Industrial output was erratic from 1990 to 1994, from minus 6.5 per cent in 1991 to positive growth of 6.5 per cent in 1994. Overall, however, only a 1.2 per cent average annual growth rate was achieved by Canadian industry during this period.

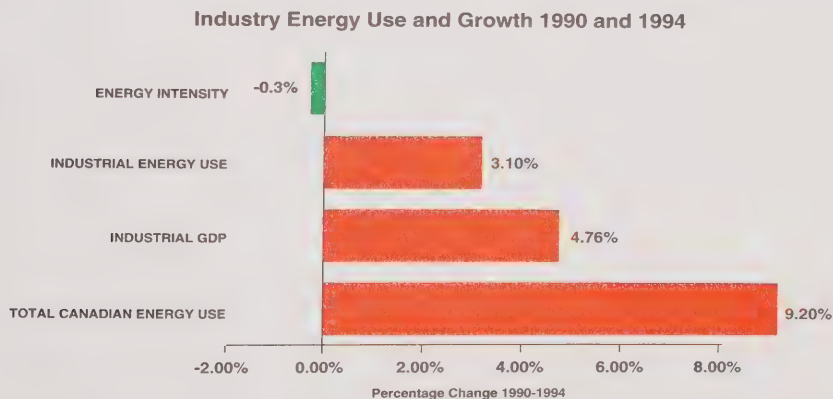
Figure 5



Source: StatsCan SO4 & MO4

From 1990 to 1994, while total Canadian energy use rose by 9.2 per cent and industrial output rose by 4.8 per cent, industrial energy use rose only 3.1 per cent. As a result, industrial energy intensity (industrial energy use divided by industrial GDP) improved slightly by 0.3 per cent.

Figure 6



Energy Efficiency By Sector: 1990 to 1994

For purposes of this annual report, industry is grouped into four categories: Tier 1 "Base"; Tier 1 "New Reporting", Tier 2 sectors and all other sectors on which energy use data is collected but on an aggregated basis. See also Appendix 1.

Figure 7

Tier 1 "Base" Sectors 69.7 % of Total Industrial Energy Use	Tier 1 "New Reporting" Sectors 9.1 % of Total Industrial Energy Use	Tier 2 Sectors	All Other Industrial Sectors
		21.2 % of Total Industrial Energy Use	
Cement Chemicals Metal Mining Petroleum Refining Pulp & Paper Smelting and Refining Steel	Glass Non Metal Mining Oil Sands/Upgraders	Breweries Chemical Fertilizers Electrical and Electronics Food Industry • Bakery • Dairy • Fruit and Vegetables • Meat and Poultry Foundries General Manufacturing • Clothing • Furniture • Leather/Allied • Machinery • Metal Fabrication • Printing/Publishing • Tobacco • All other Lime Plastics Rubber Textiles Transportation Wood Products	See Appendix 1 on Page 71

Tier 1 sectors contain companies that are large users of energy, while Tier 2 companies use more modest amounts of energy.

Tier 1 "Base" Sectors are those for which energy consumption data has been collected since 1990. Tier 1 "New Reporting" sectors are those for which data was first collected in 1994.

No data was collected in the 1994 ICE Survey on Tier 2 companies. In 1995, the ICE Survey will be sent to almost 2,000 companies which will enable data to be collected for most Tier 2 sectors.



CIPEC

Energy Efficiency By Sector: 1990 to 1994

Figure 8 lists in descending order the amount of energy consumed by sectors in 1990 and 1994.

Figure 8

Industrial Energy Use by Sector: 1990 and 1994

	1990 Terajoules	% of Total	1994 Terajoules	% of Total	% Change
Tier 1 "Base"					
Pulp & Paper*	739,823	28.5%	847,135	31.6%	14.51%
Petroleum Products	303,666	11.7%	273,303	10.2%	-10.00%
Refining**					
Steel	219,305	8.4%	236,937	8.8%	8.04%
Smelting and Refining	195,831	7.5%	221,217	8.3%	12.96%
Chemicals***	159,598	6.1%	170,710	6.4%	6.96%
Metal Mining	99,256	3.8%	69,507	2.6%	-29.97%
Cement**	52,575	2.0%	47,659	1.8%	-9.35%
Sub Total	1,770,054	68.1%	1,866,468	69.7%	1.6%
Tier 1 "New Reporting"					
Oil Sands/Upgrader	145,932	5.6%	189,350	7.1%	29.75%
Non Metal mining	38,740	1.5%	39,679	1.5%	2.42%
Glass	12,105	0.5%	14,103	0.5%	16.51%
Sub Total	196,777	7.6%	243,132	9.1%	1.5%
Total All Tier 1	1,966,831	75.7%	2,109,600	78.8%	3.1%
All Other Sectors including Tier 2	631,534	24.3%	569,188	21.2%	-3.1%
All Industry	2,598,365		2,678,788		3.1%

Source: Statistics Canada, NRCan and CIPEC Task Forces

* In 1994, only 26 per cent of the energy used in the pulp and paper sector was based on fossil fuel. The rest was mainly biomass and hydro electric power.

** The petroleum refining and cement sectors have revised the data the industry provided to Statistics Canada in 1990 as explained in greater detail in their sections of this report.

*** Historic and forecast energy use data shown in this report for the chemical sector are based on Statistics Canada's ICE survey as for other CIPEC sectors. The Canadian Chemical Producers' Association (CCPA) annual Reducing Emissions report covers emissions and projections for all greenhouse gases for all its members. The CCPA methodology does not correspond directly with the energy use data reported by StatsCan.

Energy Efficiency by Sector - Tier 1 "Base"

Tier 1 "Base" Sectors

Seven sectors - pulp and paper, petroleum refining (petroleum products), smelting and refining, steel, chemicals, metal mining and cement consumed just over 69 per cent of all the energy used by industry in 1994. Between 1990 and 1994, energy consumption in these sectors increased by 1.6 per cent. See Figure 9.

Figure 9

Tier 1 "Base" Sectors: 1990 and 1994

Tier 1 "Base"	1990 Terajoules	% of Total	1994 Terajoules	% of Total	% Change
Pulp & Paper*	739,823	28.5%	847,135	31.6%	14.51%
Petroleum Products Refining**	303,666	11.7%	273,303	10.2%	-10.00%
Steel	219,305	8.4%	236,937	8.8%	8.04%
Smelting and Refining	195,831	7.5%	221,217	8.3%	12.96%
Chemicals***	159,598	6.1%	170,710	6.4%	6.96%
Metal Mining	99,256	3.8%	69,507	2.6%	-29.97%
Cement**	52,575	2.0%	47,659	1.8%	-9.35%
Sub Total	1,770,054	68.1%	1,866,468	69.7%	1.6%

Source: Statistics Canada, NRCan and CIPEC Task Forces

- * In 1994, only 26 per cent of the energy used in the pulp and paper sector was based on fossil fuel. The rest was mainly biomass and hydro electric power.
- ** The petroleum refining and cement sectors have revised the data the industry provided to Statistics Canada in 1990 as explained in greater detail in their sections of this report.
- *** Historic and forecast energy use data shown in this report for the chemical sector are based on Statistics Canada's ICE survey as for other CIPEC sectors. The Canadian Chemical Producers' Association (CCPA) annual Reducing Emissions report covers emissions and projections for all greenhouse gases for all its members. The CCPA methodology does not correspond directly with the energy use data reported by StatsCan

Four sectors - smelting and refining, pulp and paper, chemical products and Steel - increased the amount of energy consumed between 1990 and 1994. Three sectors - cement, petroleum products refining, and metal mining - reduced the amount of energy they consumed.

Each Tier 1 "Base" status report presented below has been approved by its Sector Task Force and the related trade association.

For the most part, each sector report identifies for the years 1990, 1991, 1992, 1993 and 1994:

- the amount of energy used in Terajoules,
- the units of output for each sector,
- the energy efficiency rate (energy use divided by units of output), and
- the sector's energy efficiency index (a comparison based on 1990 equaling 100).

Energy Efficiency by Sector - Tier 1 "Base"

The objective is to show the energy efficiency or energy intensity performance of each sector from 1990 through 1994 and to identify the annual energy reduction commitment of each sector from 1995 to 2000.

Energy Efficiency Performance

All seven Tier 1 "Base" sectors demonstrated increased energy efficiency (EE) between 1990 and 1994, as illustrated in Figure 10.

Figure 10

Industrial Sectors	Increase (Decrease) in Energy Efficiency	Increase (Decrease) in Energy Intensity*
Tier 1 "Base"		
Pulp & Paper (Fossil fuel)	19.20%	
Petroleum Refining	9.23%	
Steel	16.6%**	
Smelting and Refining		6.23%
Chemicals		0.22%***
Cement	8.5%	
Metal Mining	12.0%	
Tier 1 "New Reporting"		
Oil Sands/Upgrader	13.21%	
Non Metal mining		2.67%
Glass	(4.9%)	

Source: StatsCan and Sector Task Forces

* Energy efficiency is the energy use divided by industrial production. Energy intensity is measured by a sector's energy use divided by the sector's GDP. A () sign = less energy efficient / less energy intensive.

** Based on an adjusted energy rate for 1990

*** Historic and forecast energy use data shown in this report for the chemical sector are based on Statistics Canada's ICE survey as for other CIPEC sectors. The Canadian Chemical Producers' Association (CCPA) annual Reducing Emissions report covers emissions and projections for all greenhouse gases for all its members. The CCPA methodology does not correspond directly with the energy use data reported by StatsCan.

Forms of Energy Used and Trends

CIPEC Annual Reports up to 1990 included information by sector on the type of energy being used, for example, coal, petroleum products, natural gas, electricity.

It is our hope that the ICE survey will enable us to provide this kind of information in next year's annual report.

Pulp and Paper

The pulp and paper industry consumed 31 per cent of Canada's total industrial energy in 1994.

Biomass energy (pulp liquor, waste wood, etc.), however, constituted over 53 per cent of the energy consumed by this sector in 1994. The pulp and paper industry used 22 per cent more biomass in 1994 than it did in 1990.

Electrical energy comprised 22 per cent of the sector's total energy requirements, most of which is derived from hydraulic sources. Only 26 per cent of this sector's energy use is based on fossil fuel.

Figure 11 compares the sector's total energy use, units of output, its energy efficiency rate, and its energy efficiency index from 1990 through 1994.

Figure 11

Pulp and Paper Energy Efficiency Including Biomass Energy

Measure	1990	1991	1992	1993	1994
Total Energy Use (Terajoules)	739,823	751,583	757,280	742,800	847,136
Production (Kilotonnes)	26,131	26,323	27,217	28,814	31,468
Energy / Production (GJ/T)	28.31	28.55	27.82	25.78	26.92
Energy / Production Indexed	1.000	1.008	0.983	0.911	0.951

Source: StatsCan, NRCan, CIEEDAC, Sector Task Force

During the period 1990 to 1994, pulp and paper production increased by 20 per cent, while total energy consumption per tonne declined by 5 per cent, despite an estimated 2 per cent electrical energy consumption increase attributed to the installation of environmental equipment. This reduction reflects improved energy efficiency.

Figure 12 shows the corresponding comparison based only on fossil fuel consumption.

Figure 12

Pulp and Paper Energy Efficiency - Fossil Fuel Only

Measure	1990	1991	1992	1993	1994
Total Energy Use (Terajoules)	223,625	223,448	210,856	211,845	217,604
Production (Kilotonnes)	26,131	26,323	27,217	28,814	31,468
Energy / Production (GJ/T)	8.558	8.489	7.747	7.352	6.915
Energy / Production Indexed	1.000	0.992	0.905	0.859	0.808

Source: StatsCan, NRCan, CIEEDAC, Pulp and Paper Sector Task Force

From 1990 to 1994, fossil fuel consumption declined in absolute terms, while fossil fuel consumption per unit of production declined by 19 per cent, as a result of process improvements and fuel substitution. See Figure 13.

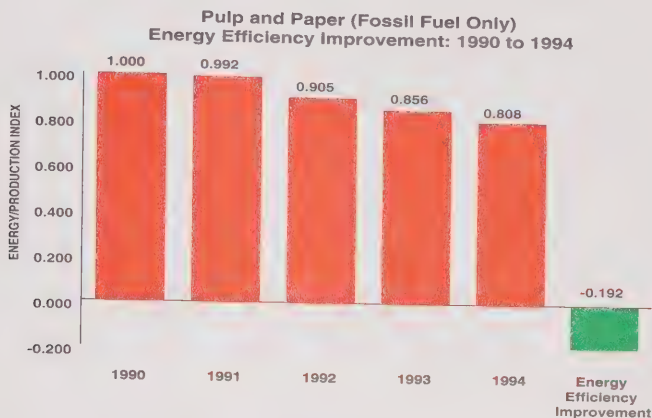


CIPEC

Energy Efficiency by Sector - Tier 1 "Base"

Pulp and Paper

Figure 13



The industry also instituted changes which enabled better utilization of forest resources, including investing in thermo-mechanical pulp technology to produce newsprint replacing groundwood technology, and replacing virgin fibre with recycled fibre.

The average recycled content of newsprint rose from 1.1 per cent in 1990 to almost 16 per cent in 1994, representing an increase of 1.35 million tonnes and reducing the pulp and paper industry's electricity consumption by over 2.5 million MWh per year.

The fibre recycling activities enabled residual fibre to be diverted from landfill sites, thereby eliminating the carbon dioxide and methane emissions that would have resulted from its decomposition.

The industry also cooperated with local electrical utilities in their energy saving programs. For example, Ontario Hydro sponsored programs saved the industry over 160,000 MWh/year of electrical power. This is equivalent to the power used by a city of 16,000 inhabitants. The reduction in carbon dioxide emissions from this one initiative alone is about 150,000 tonnes per year.

The off-site activities of the industry also contributed to the reduction of "greenhouse" gases. A land utilization program enabled residual materials, biosolids formerly considered to be waste, to be utilized as a resource. Biosolids are used by the agricultural community, in lieu of manure and chemical fertilizers, and by others for industrial site rehabilitation, reforestation and afforestation.

Pulp and Paper Energy Efficiency Commitment: 1995 - 2000

The pulp and paper sector is committed to improving its energy efficiency by 1.0 per cent per unit of output per year for the period 1995 to 2000.

Pulp and Paper

Pulp and Paper Task Force

Norman Pridham, QUNO Corp., Chairman
Bob Eamer, Domtar Inc.
Dick Bryan, Council of Forest Industries
Robert Jobin, Kruger Inc.
A. J. Chmelauskas, MacMillan Bloedel Limited
Mike Kuriychuk, Avenor Inc.
Ray Norgen, Weyerhaeuser Canada Ltd.
H. I. Simonsen, Consultant, Canadian Pulp and Paper Association (CPPA)
George Weyerhaeuser, Jr. Weyerhaeuser, Canada Ltd.
Tim Whitford, Weldwood of Canada
Pierre Vézina, AIFQ
Jean-Pierre Martel, CPPA

Energy Efficiency Initiatives - Pulp and Paper

The following are examples of energy efficiency initiatives undertaken in the pulp and paper sector:

QUNO's Thorold mill conversion from a thermomechanical pulp process to the production of newsprint from recycled fibre (old newspapers and magazines) has resulted in electrical power savings of over 500,000 MWh/year. This is equivalent to the power consumed by a city of 50,000 people. "Old news is not only good news, but also good energy efficiency news".

The Thorold mill is the most energy efficient newsprint mill in Canada, consuming only 12.84 GJ/tonne of product.

By using old newspapers and magazines, QUNO consumes 250,000 tonnes/year of waste fibre which would have gone into landfill sites, creating carbon dioxide and methane emissions.

Since 1990, QUNO's Baie Comeau mill has reduced its overall energy use by 8 per cent and, more importantly, reduced its fossil fuel consumption by over 75 per cent. This has been achieved by the substitution of woodwaste and bark for fuel oil.



CIPEC

Energy Efficiency by Sector - Tier 1 "Base"

Petroleum (Products) Refining

The petroleum products subsector of petroleum refining is Canada's second largest industrial user of energy consuming 10 per cent of total industrial energy. It includes 23 refineries and a network of distribution channels, bulk plants and 17,000 retail outlets.

The two oil sands plants, located in northern Alberta, and one heavy oil upgrader in Saskatchewan, which are the other subsector of petroleum refining, are reported separately this year under the Tier 1 "New Reporting" category.

Petroleum (products) refining employs over 100,000 Canadians directly and another 250,000 indirectly.

Total energy use, units of output, the sector's energy efficiency rate, and the overall energy efficiency index for 1990 and 1994 are shown in Figure 14.

The petroleum products industry's energy use numbers for both 1990 and 1994 differ from those recorded by StatsCan. The revised data is based on an extensive re-examination of the data base to ensure a consistent and accurate reporting format. The industry revised data should now be considered the base numbers from which the sector will henceforth be measured.

Figure 14

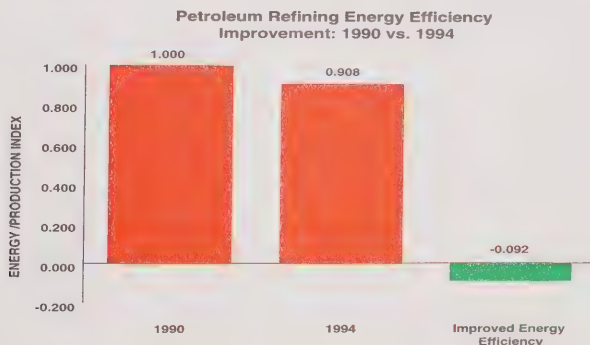
Petroleum Products Energy Efficiency: 1990 to 1994

Measure	1990		1994	
	StatsCan Data	Revised Industry Data	StatsCan Data	Revised Industry Data
Total Energy Use (Terajoules)	291,235	303,666	290,344	273,306
Production (Cubic metres)	75,873	75,873	75,229	75,229
Energy / Production (GJ/Cubic metres)	3.838	4.002	3.859	3.633
Energy / Production Indexed	1.000	1.000	1.005	0.908

Source: StatsCan, NRCan, CIEEDAC, Petroleum Refining Sector Task Force

In essence, the petroleum refining energy efficiency (energy use divided by output, measured in cubic metres) improved by 9.2 per cent between 1990 and 1994.

Figure 15





CIPEC

Energy Efficiency by Sector - Tier 1 "Base"

Petroleum (Products) Refining

Energy Efficiency Improvements: 1972 to 1990

From 1972 through 1990, the petroleum products sub-sector improved its energy efficiency by 32.5 per cent through a combination of capital investments, operating and technological improvements, and operating and maintenance personnel training.

Energy Efficiency Improvements: 1991 to 1994

When measured on a per unit of output basis, the petroleum products sub-sector has recorded a 9.2 per cent reduction in the amount of energy used to produce a thousand cubic metres of output, - going from 4.0 Gigajoules of energy in 1990 to 3.6 Gigajoules in 1994 (this calculation is based on higher heating values). This is confirmed by the internationally recognized Solomon Energy Efficiency Index which records an energy efficiency of almost 8.8 per cent for the period 1990 to 1994 (this calculation is based on lower heating values).

Since 1990, the sub-sector has gone through a major restructuring to improve its economic efficiency: six refineries have been shutdown; 5,000 to 6,000 retail service stations and a number of terminals and bulk plants have also closed.

The focus on energy efficiency has been increased application of advanced control and optimization technology, operating efficiency improvements and modest capital investments.

Petroleum Products Energy Efficiency Commitment: 1995 - 2000

The petroleum products sector is committed to improving its energy efficiency by 1.0 per cent per unit of output per year for the period 1995 to 2000.

This will be a significant challenge in tandem with improving the environmental performance of gasoline and diesel fuel. In addition, refiners will be dealing with ever changing crude feedstocks which can impact the energy intensity of operations.

The industry is confident that it will deliver on its commitment through further implementation of advanced process control, operating improvements, training and selected capital investments.



CIPEC

Energy Efficiency by Sector - Tier 1 “Base”

Petroleum Refining

Petroleum Refining Task Force

Peter Baltais, Imperial Oil Limited
Jack Burkholder, CIPEC, Secretariat Support
Bob Clapp, CPPI - National
Burt Lang, Suncor Inc., Oilsands Group
Bob LeFlar, Parkland Refining Ltd.
Pierre Moreau, Ultramar Canada Inc.
John Retallack, Novacor Chemicals (Canada)
Mike Stephen, Chevron Canada Limited
Kees Versfield, Syncrude Canada Ltd.

Doug Mah, Consumers Co-op Refiners Ltd.
Bruce Cater, Sunoco Group, Suncor Inc.
Richard Fry, CIPEC, Technical Support
Jim LeBlanc, Irving Oil Limited
Dave McAfee, Petro-Canada
John Nyboer, CIEEDAC, Simon Fraser University
Ron Schmitz, Husky Oil Operations
Nick Tremblay, Shell Canada Products Limited

Energy Efficiency Initiatives - Petroleum Refining

Over the past year, the following energy efficiency initiatives were taken by companies in the petroleum refining sector:

Power Recovery Turbine

As part of Ontario Hydro's Power Saving Study Program, a company invested \$1.4 million to install a power recovery turbine on a process unit. The facilities recovered energy lost in the process and transformed it into 700 kilowatts of electrical energy. The impact of this was to reduce carbon dioxide emissions by 4,600 Tonnes a year.

Operating Improvements

A series of operational improvements have been initiated by the industry, including:

- improving efficiency of heaters and boilers
- optimizing refinery steam systems
- steam trap upgrade and repair programs
- use of variable speed motors
- low level heat programs
- pump upgrade programs

Office Building Management

One company reduced office building energy consumption by 15 per cent since 1990 through the following initiatives:

- use of light sensors in low traffic areas
- reduce lighting levels
- low energy lighting
- building generators to reduce peak loads
- shutdown of equipment during non-peak hours.

Steel

The steel sector is Canada's third largest industrial user of energy, consuming 9 per cent of Canada's total industrial energy in 1994.

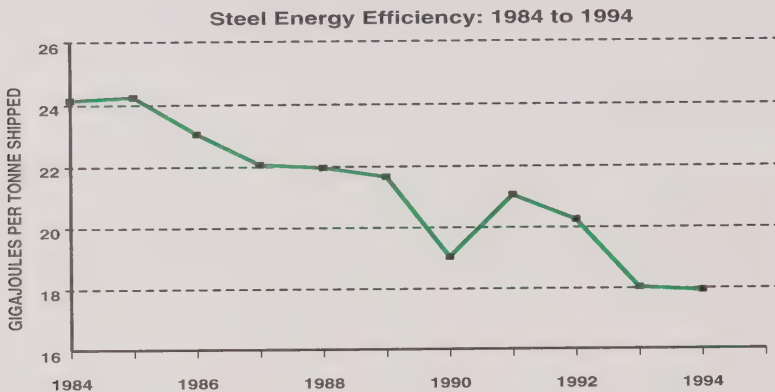
Companies participating in CIPEC are members of the Canadian Steel Environmental Association (CSEA), part of the Canadian Steel Producers Association (CSPA). CSEA represents 93 per cent of the production capacity of the Canadian steel industry and includes Algoma, Co-Steel Lasco, Courtice, Dofasco, IPSCO, Ivaco, Manitoba Rolling Mills, Sammi Atlas (Specialty), Sidbec-Dosco (ISPAT), Slater and Stelco.

In 1994, the Canadian steel industry produced 13.8 million tonnes of steel and shipped 13.4 million tonnes. Products range from primary products such as rails, structural shapes, bars and rods, to hot rolled strip and plate, to highly finished cold rolled sheets and coated materials.

Markets served are broad and varied, including automotive vehicles and parts, appliances, packaging, construction, wire and wire products, pipe and tube and the steel service centre wholesale market.

Figure 16 traces the significant decline in Gigajoules of energy consumed per tonne of steel shipped from 1984 to 1994.

Figure 16



Source: Energy: StatsCan QRESO SIC 2910
Shipments: StatsCan Cat #41-001

Improvement in the sector's energy efficiency can be traced to a number of factors, including:

- raw material changes, such as increased use of:
 - higher concentrations of iron in the pelletizing ores used by blast furnaces,
 - recycled steel scrap;



CIPEC

Energy Efficiency by Sector - Tier 1 "Base"

Steel

- process changes such as:
 - increased use of electric arc furnace melting
 - close coupling of continuous casting with hot rolling, or pickling with cold rolling
 - investment in equipment like continuous casting machines to improve product yields
 - increased use of high efficiency equipment such as advanced motors and lights.

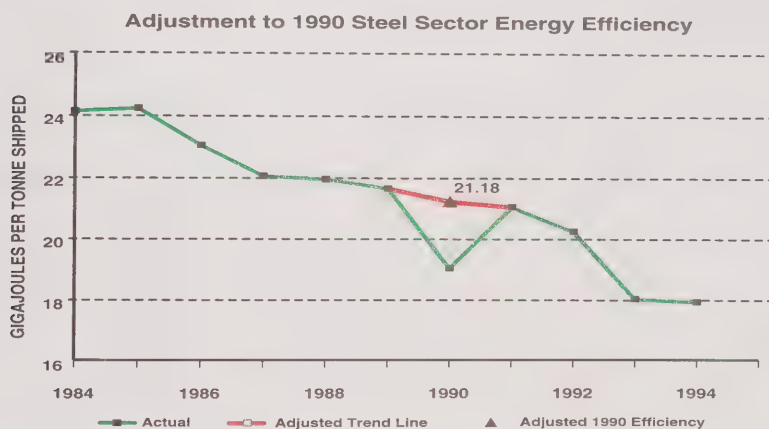
Adjustment to the 1990 Energy Efficiency Rate

In 1990, prolonged labour disruptions - four to five months - at two large steel companies caused an unusual decrease in the energy rate that year.

Steel production at these companies is based on the iron ore- blast furnace-oxygen steelmaking route. With their shut-down, the proportion of electric furnace-scrap remelting steelmaking increased significantly in Canada. The consequence was an unusually low energy rate.

The actual energy 1990 use, as shown in Figure 16, is 10.4 per cent less than the 21.18 GJ/tonne shipped that would have appeared in a normal year. This adjustment is indicated in Figure 17.

Figure 17



Source: Energy: StatsCan QRES SIC 2910
Shipments: StatsCan Cat #41-001
Steel Sector Task Force

Steel

Energy Efficiency Performance

Figure 18 compares total energy use, units of output, the sector's energy efficiency rate, and the overall energy efficiency index from 1990 through 1994.

Figure 18

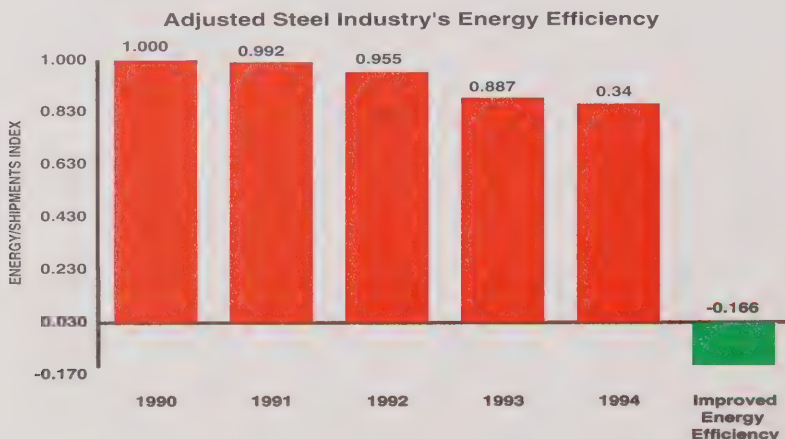
Steel Industry's Energy Efficiency : 1990 to 1994

Adjusted 1990	1990	1990 Adjusted	1991	1992	1993	1994
Total Energy Use (Terajoules)	219,305	no change	236,142	246,970	241,546	236,937
Shipments (tonnes)	11,563,101	no change	11,241,164	12,207,144	13,312,911	13,406,027
Energy / Shipments (GJ/tonnes)	18.97	21.18	21.01	20.23	18.14	17.67
Energy / Shipments Indexed		1.000	0.992	0.955	0.857	0.834

Source: StatsCan, NRCan, CIEEDAC, Steel Sector Task Force

Figure 19 illustrates that the sector's adjusted energy efficiency (energy use divided by shipments, measured in kilo tonnes) improved by 16.6 per cent over the period 1990 to 1994.

Figure 19



Energy Efficiency Commitment:

The steel sector is committed to improving its energy efficiency by 1.0 per cent per unit of output per year averaged over the period 1990 to 2000 based on the adjusted base year rate of 21.18 GJ / tonne shipped.



CIPEC

Energy Efficiency by Sector - Tier 1 "Base"

Steel

Steel Task Force

Susan Olynyk, Dofasco Inc., Chair

Al Schuldt, Stelco Ltd.

Energy Efficiency Initiatives - Steel

Over the past year, the following were among the energy efficiency initiatives undertaken by companies in the steel sector:

Co-Steel Lasco

At the electric arc steelmaking vessel, a submerged arc practice was adopted. In concert with a foamy slag operation, the submerged arc allows the arc size to be optimized and thereby saves electricity.

Dofasco

At the #3 Coke Plant, measurement of final coke temperature and the use of control charts helped to improve coke oven battery heating, improve resulting coke quality and hence achieve energy savings at the blast furnaces.

Slater

Installation of a billet extractor rolling mill reheat furnace provided a reduction in natural gas and electricity consumption for Rolling Operations as a result of improved mill efficiency.

Stelco

Improvements to the skid system insulation in the Hot Strip Mill at Lake Eire Works reduced natural gas consumption by 480 Terajoules a year, a decrease in furnace fuel consumption of 27 per cent.

Upcoming Activities

At Dofasco, the startup in late 1996 of an electric arc/continuous casting facility to replace BOF steelmaking/mgot casting facilities shutdown in 1993 will reduce specific energy consumption 10 to 20 per cent.

At Slater Steel, improvements to the utilization of oxygen in the Oxygen/Carbon lance on the arc furnace will provide expected electricity reductions of 7 Kwh/ton in its steelmaking operations.

At Stelco's Hilton Works, the use of pulverized coal injection at the blast furnaces and associated reductions in the amount of coke produced will increase overall plant efficiency.

Non Ferrous - Smelting and Refining

The non ferrous smelting and refining sector is Canada's fourth largest industrial user of energy, consuming 8 per cent of Canada's total industrial energy. It includes primary aluminum production and primary smelting and refining of non ferrous metals.

Figure 20 compares total energy use, units of output, the sector's energy efficiency rate, and the overall energy efficiency index from 1990 through 1994.

Figure 20

Non Ferrous Smelting and Refining's Energy Intensity: 1990 to 1994

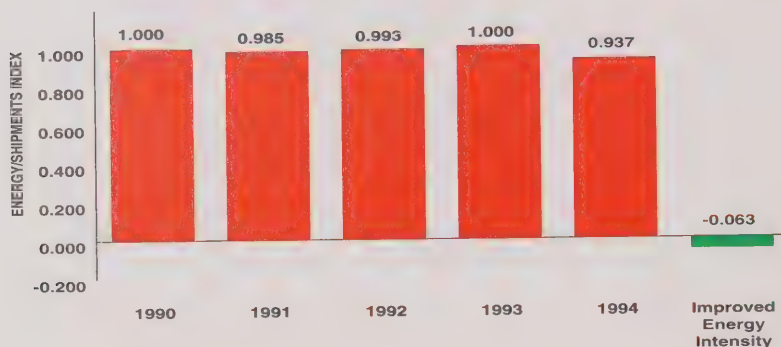
Measure	1990	1991	1992	1993	1994
Total Energy Use (Terajoules)	195,831	209,624	220,751	243,518	221,217
Gross Output (Millions of constant '86\$)	8,146	8,849	9,247	10,060	9,818
Energy / Production (MJ/\$)	24.040	23.689	23.873	24.207	22.532
Energy / Production Indexed	1.000	0.985	0.993	1.007	0.937

Source: StatsCan, NRCan, CIEEDAC, Non-Ferrous Smelting and Refining Sector Task Force

The smelting and refining sector's energy intensity (energy use divided by output, constant 1986 dollars) improved by 6.3 per cent between 1990 and 1994.

Figure 21

Non Ferrous Smelting and Refining's Energy Intensity: 1990 to 1994



Primary Aluminum Production

Aluminum production comprised almost 72 per cent of the energy used by the smelting and refining sector in 1994.

Electric power represents almost 30 per cent of aluminum production costs. The increase in the price of a kWh of electricity and the large volume of electricity required to produce aluminum were strong incentives for developing technologies capable of greater energy efficiency.



CIPEC

Energy Efficiency by Sector - Tier 1 "Base"

Non Ferrous - Smelting and Refining

Energy Efficiency Commitment: 1995 - 2000

The aluminum and non-ferrous sector is committed to improving its energy efficiency by 1.0 per cent per unit of output per year for the period 1995 to 2000.

Non Ferrous Smelting and Refining Task Force

John Owen, Falconbridge Limited
Peter McBride, Ontario Mining Association
Keith Eldridge, Iron Ore Company
Rick Green, Noranda
John Lemay, INCO Ontario Division
Milt Goble, INCO Manitoba Division
Anthony Howard, Echo Bay
Kees Versfeld, Syncrude
Gerry Villianotos, Falconbridge
Henry Smith, Williams Operating
John McDonald, Placer
Christian Van Houtte, Aluminum Industry Association

Energy Efficiency Initiatives - Non Ferrous Smelting and Refining

Aluminum

Since 1940, the average quantity of energy required to produce one kilogram of aluminum has been cut in half, from 27 KW/h to 13.5 KW/h. Nearly 80 per cent of the aluminum produced in Canada comes from smelters using state of the art technologies. Therefore, even with a considerable increase in the overall Canadian production since the beginning of the 1990's, the total demand for energy has declined.

Better work practices:

To be efficient, the best technologies must be coupled with work practices favouring energy savings. The fine tuning of equipment and the rational use of all energy sources—electricity, natural gas, fuel—contribute to a cost reduction, an improvement in the quality of the environment and to greater production performance.

Recycling:

The recycling of aluminum saves 95 per cent of the energy needed to produce new metal from raw materials. In Canada, enough electricity is saved this way to supply the total energy needs of 15,000 households for an entire year. It is expected that by the year 2000, recycled aluminum will account for 40 per cent of the world aluminum consumption. Aluminum can be recycled almost indefinitely without losing its properties.



Energy Efficiency by Sector - Tier 1 "Base"

Non Ferrous - Smelting and Refining

Energy Efficiency Initiatives - Non Ferrous Smelting and Refining

Utilization:

Whatever its use, aluminum contributes to energy savings. Cans are lighter than steel or glass and are easier and cheaper to transport; they are 100 per cent recyclable. Planes, railroad cars, trailers, buses are all built with aluminum and the weight reduction generates substantial energy savings.

Noranda Metallurgy - CCR Refinery

Noranda's CCR refinery initiated an energy efficiency program in 1990. Now in its fifth year, the program is achieving annual energy savings of 24 per cent or \$2.5 million versus 1990. Carbon dioxide emissions have been reduced by 25,000 tonnes a year.

Hudson Bay Mining and Smelting

Installation of new technology completed in 1993 is resulting in energy savings of 800 terajoules per year. Carbon dioxide emissions are 50 per cent or 170,000 tonnes lower. Further energy efficiency measures are expected to produce savings of \$1 million per year.



CIPEC

Energy Efficiency by Sector - Tier 1 "Base"

Chemical Products

The chemical products sector is Canada's fifth largest industrial user of energy, consuming 6 per cent of total industrial energy in 1994. The sector includes industrial chemicals (SIC 371) and plastics and resins (SIC 3731).

Figure 22 compares total energy use, units of output, the sector's energy efficiency rate, and the overall energy efficiency index from 1990 through 1994.

Figure 22

Chemical Products Energy Intensity: 1990 to 1994*

Measure	1990	1991	1992	1993	1994
Total Energy Use (Terajoules)	175,701	184,625	164,988	157,156	196,544
Production (Millions '86\$)	10,056	11,071	11,056	11,070	11,274
Energy / Production (MJ/86\$)	17.472	16.676	14.923	14.197	17.443
Energy / Production Indexed	1.000	0.954	0.854	0.813	0.998

Source: StatsCan, NRCan, CIEEDAC.

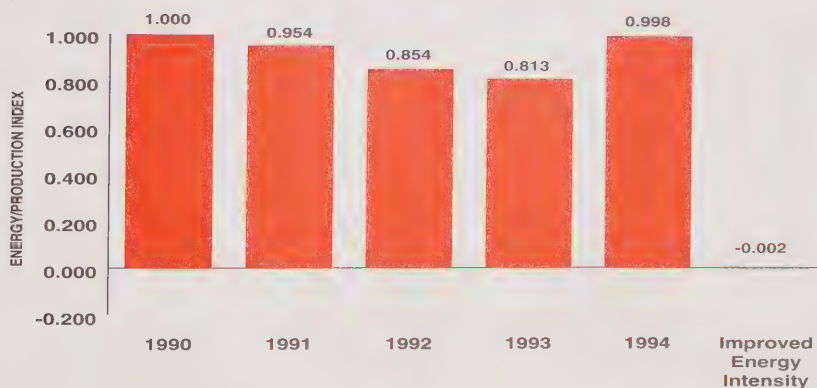
* Historic and forecast energy use data shown in this report for the chemical sector are based on Statistics Canada's ICE survey as for other CIPEC sectors. The Canadian Chemical Producers' Association (CCPA) annual Reducing Emissions report covers emissions and projections for all greenhouse gases for all its members. The CCPA methodology does not correspond directly with the energy use data reported by StatsCan.

The chemical products sector's energy intensity improved by 0.20 per cent between 1990 and 1994.

(The energy/production index is determined by dividing energy use by output. For the chemical industry, the output currently being used is a surrogate measured in constant 1986 dollars and is preliminary to identifying an industry unit of output.)

Figure 23

Chemical Products Energy Intensity: 1990 to 1994



Metal Mining

The metal mining sector is Canada's sixth largest industrial user of energy, consuming 2.6 per cent of Canada's total industrial energy.

Because transportation is an integral part of this industry, diesel and other transportation fuels are included in this sector's energy use data.

The Canadian mining industry directly employs 335,000 people and indirectly creates jobs for another 258,000. It is the mainstay of 150 communities.

In 1994, the industry generated \$20 billion in income in Canada, provided almost 15 per cent of Canada's total exports and contributed \$9.9 billion to the mineral trade balance.

Canada is a world leader in high-tech mining. The industry invests more than \$100 million annually in research and development; 85 per cent of the workforce uses advanced technology.

Because mining is, by nature, highly energy intensive, energy management is the way of doing business - not a "flavour of the month". Reflecting this philosophy, in the period 1990 to 1994, the industry's energy efficiency improved by 13 per cent.

Figure 24 compares total energy use, units of output, the sector's energy efficiency rate, and its overall energy efficiency index.

Figure 24

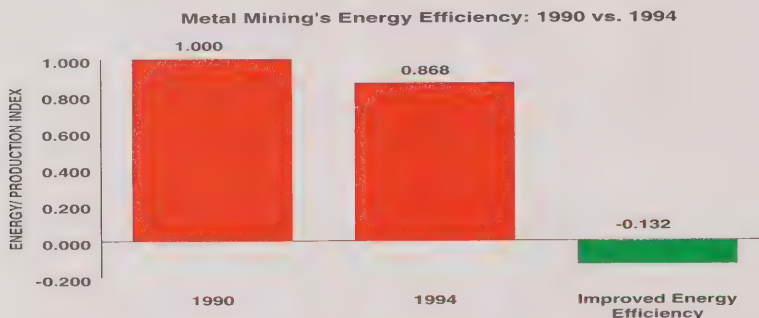
Metal Mining's Energy Efficiency: 1990 to 1994

Measure	1990	1994
Total Energy Use (Terajoules)	99,256	69,509
Production (Kilotonnes)	2,610,720	2,077,133
Energy / Production (GJ/T)	0.038	0.033
Energy / Production Indexed	1.000	0.868

Source: StatsCan, NRCan, CIEEDAC, Metal Mining Sector Task Force

The mining and metallurgy sector's energy efficiency (energy use divided by output, measured in kilotonnes) improved by 13.2 per cent between 1990 and 1994.

Figure 25



Metal Mining

The mining industry has the three most energy efficient zinc plants in the world, the most energy efficient nickel producer and the lowest cost nickel producer in the western world.

Energy Efficiency Commitment: 1995 - 2000

The mining sector is committed to improving its energy efficiency by 1.0 per cent per unit of output per year for the period 1995 to 2000.

Metal Mining Task Force

John Owen, Falconbridge Limited, Chairman
Milt Goble, INCO Manitoba Division
Peter McBride, Ontario Mining Association
Anthony Howard, Echo Bay
Keith Eldridge, Iron Ore Company
Kees Versfeld, Syncrude
Rick Green, Noranda
Gerry Villianotos, Falconbridge
John Lemay, INCO Ontario Division
Henry Smith, Williams Operating

Energy Efficiency Initiatives - Metal Mining

Inco Limited

Between 1990 and 1991, Inco's Ontario Division improved its energy performance by 20 per cent. Overall energy use per pound of copper and nickel produced improved by 7.2 per cent from 1992 to 1993 and another 3.9 per cent from 1993 to 1995.

Falconbridge Limited

Through a combination of capital and non-capital projects, the formation of energy management teams, changed purchasing specifications and senior management commitment, Falconbridge reduced energy consumption by 6.5 per cent between 1990 and 1994.

Energy efficiency increased by 15.5 per cent during the same period. Two Falconbridge plants are among the most energy efficient in the world.

Iron Ore Company of Canada (IOC)

Automation initiatives at the Carol Pellet Plant in Labrador City, Newfoundland are producing:

- fuel savings of 10 per cent and 6 per cent, respectively, for acid and fluxed pellets
- a pellet productivity increase of 5 per cent and an improvement on pellet quality

If this level of improvement continues, IOC expects to reduce bunker C oil consumption by 9 million litres per year and annual carbon dioxide emissions by 28 kilotonnes.

Cement

The cement sector is composed of nine companies. It consumed 1.8 per cent of total industrial energy in 1994.

In 1996, the sector is expected to expand to become the Industrial Minerals sector, with the inclusion of the two major glass producers in Canada and the membership of the Canadian Lime Institute.

Significant energy efficiency improvements were made in the late 1980's by the cement sector through extensive capital investments in new technology, which have extended capital cycles. Current efficiency gains have come mainly from operating practices.

Based on industry reporting, the sector showed an 8.5 per cent energy efficiency improvement between 1990 and 1994. This was achieved despite a sluggish economy, a slow-down in infrastructure and other construction activity and mandated increased use of electricity for environmental abatement, estimated to be about 2 per cent.

Production of cement and exported clinker for the period declined from a high of 11.5 million tonnes in 1990, to a low of 9.6 million tonnes in 1992. It rebounded to 11.4 million tonnes in 1994, helped in part by export sales to the U.S. market as that economy recovered sooner and stronger than in Canada. Cement and clinker exports were 4.0 million tonnes in 1993, and 4.8 million tonnes in 1994, a 20% increase.

The cement industry's energy use and production numbers for both 1990 and 1994 differ from those recorded by Statistics Canada. The most significant difference between the two surveys is the conversion rate used to determine the energy content of various fuels. In the industry survey, each respondent identified the energy content of the fuel reported. In the StatsCan survey, the companies provided information on the types of energy used and StatsCan applied a uniform conversion rate to calculate the energy content of each fuel classification. There were also less significant differences reported in both fuel usage and production. Because of known plant efficiency improvements in this period, the industry data is accepted as being more accurate.

Figure 26 compares total energy use, units of output, the sector's energy efficiency rate, and the overall energy efficiency index from 1990 through 1994.

Figure 26

Cement's Industry's Energy Efficiency: 1990 to 1994

Measure	1990		1994	
	StatsCan Data	Revised Industry Data	StatsCan Data	Revised Industry Data
Total Energy Use (Terajoules)	53,641	52,575	52,830	47,659
Production (tonnes)	11,542	11,107	11,418	11,001
Energy / Production (GJ/tonne)	4.647	4.734	4.626	4.332
Energy / Production Indexed	1.000	1.000	.995	0.915

Source: StatsCan, NRCan, CIEEDAC, Cement Sector Task Force

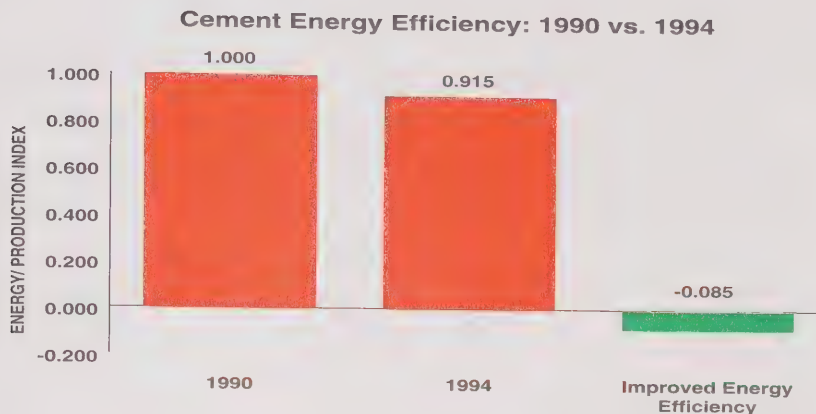


CIPEC

Energy Efficiency by Sector - Tier 1 "Base"

Cement

Figure 27



Energy Efficiency Commitment: 1995 - 2000

The cement sector is committed to improving its energy efficiency by 0.7 per cent per unit of output per year for the period 1995 to 2000, as opportunities for additional efficiencies are essentially incremental.

Cement Task Force

John Lind, St. Mary's Cement Company, Chairman

Energy Efficiency Initiatives - Cement

Examples of changes which increased the energy efficiency of the cement industry during the period 1989 and 1994, include:

- the closing of a 300,000 tonne/year plant in Winnipeg and a 200,000 tonne/year plant in Regina based on old technology
- the retirement of a 150,000 tonne/year dry kiln in Exshaw, Alberta and two 170,000 tonne/year long dry kilns in Picton, Ontario
- the replacement of two 300,000 tonne/year wet kilns with a 1.4 million tonne/year preheater/precalciner kiln in Bowmanville, Ontario
- many modifications in process equipment and operating procedures.

Energy Efficiency by Sector - Tier 1 "New Reporting"

There are three Tier 1 "New Reporting" Sectors - oil sands/upgraders, non-metal mining, and glass. These are the sectors for which data was collected for the first time in 1994 through the ICE Survey.

In 1994, these three sectors consumed 9.0 per cent of all energy used by industrial companies. All three sectors increased the amount of energy consumed between 1990 and 1994.

Figure 28

Manufacturing and Mining Energy Use by Sector: 1990 and 1994

Tier 1 "New Reporting"	1990 Terajoules	% of Total	1994 Terajoules	% of Total	% Change
Oil Sands/Upgrader	145,932	5.6%	189,350	7.1%	29.75%
Non Metal mining	38,740	1.5%	39,679	1.5%	2.42%
Glass	12,105	0.5%	14,103	0.5%	16.51%
Sub Total	196,777	7.6%	243,132	9.1%	1.5%

Source: NRCan

Energy Efficiency Performance

Tier 1 "New Reporting" Sectors	Increase (Decrease) in Energy Efficiency*
Oil Sands/Upgraders	13.21%
Non Metal mining	2.67%
Glass	(4.9%)

Source: StatsCan, NRCan, Sector Task Force

* A () sign = less efficient

Each of the Tier 1 "New Reporting" status reports presented below has been approved by its Sector Task Force and/or the related trade association. This year's report should be considered the official version because of the greater accuracy achieved in the data with the introduction of the ICE Survey and with reporting refinements initiated by the industry sectors and StatsCan.

The report identifies for each of the years from 1990 through 1994:

- the amount of energy used in Terajoules,
- the units of output for each sector,
- the energy efficiency rate (energy use divided by units of output), and
- the sector's energy efficiency index (a comparison based on 1990 equaling 100).

The objective is to show the energy efficiency performance of each sector from 1990 through 1994 and to identify the annual energy reduction commitment of each sector from 1995 to 2000

Oil Sands/Upgrader

The two oil sands plants, located in northern Alberta, and one heavy oil upgrader in Saskatchewan, while part of the petroleum refining sector, are reported upon separately this year under the Tier 1 "New Reporting" category. This is the first year the oil sands / upgrader sector is being reported on by CIPEC.

The oil sands/upgrader sector consumed 7.0 per cent of total industrial energy in 1994. Together these three plants produce over 300,000 barrels of synthetic crude oil per day for markets in the United States and Canada. They employ over 20,000 Canadians directly and another 100,000 indirectly.

Synthetic crude oil production increased between 1990 and 1994 by over 49.5 per cent but energy use increased by only 29.5 per cent. As a result, the oil sands/upgrader energy efficiency (energy use divided by output, measured in cubic metres) improved by a significant 13.21 per cent over the period.

Figure 29

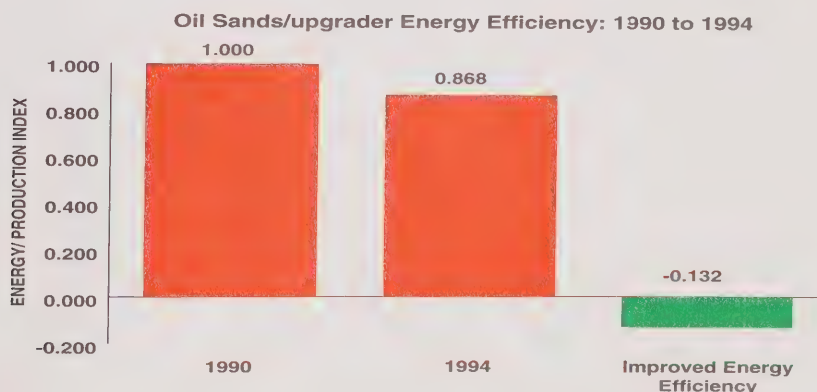
Oil Sands/Upgrader Energy Efficiency: 1990 to 1994

Measure	1990	1994
Total Energy Use (Terajoules)	145,932	189,350
Production (Cubic metres)	11,951	17,865
Energy / Production (GJ/Cubic metres)	12.212	10.599
Energy / Production Indexed	1.000	0.868

Source: StatsCan, NRCan, CIEEDAC, Petroleum Refining Sector Task Force

This has been accomplished by an aggressive program to improve plant reliability which is key to achieving energy efficiency. As well, improvements in the extraction process, the increased recovery and use of waste heat, increased yields in the processing units and the introduction of new technologies in the mining stage of operations have all contributed to improved energy efficiency.

Figure 30





Energy Efficiency by Sector - Tier 1 “New Reporting”

Oil Sands/Upgrader

Oil Sands/Upgrader Energy Efficiency Commitment: 1995 - 2000

The oil sands/upgrader sector is committed to improving its energy efficiency by 1.0 per cent per unit of output per year for the period 1995 to 2000.

The industry is confident that it will deliver on its commitment through further implementation of advanced process control, operating improvements, training and selected capital investments.

The oil sands sector, while increasing production, will continue to apply new technologies and to focus on reliability in order to drive down the energy consumed per unit of production.

Oil Sands/Upgrader Task Force

The Petroleum Refining Task Force (See page 25) oversees the activities of the Oil Sands/Upgrader sector.

Energy Efficiency by Sector - Tier 1 "New Reporting"

Non-Metal Mining

The non-metal mining sector consumed 1.5 per cent of total industrial energy use in 1994. It includes asbestos, potash, salt and miscellaneous mines. Figure 31 compares the sector's energy efficiency for 1990 and 1994.

Figure 31

Non-Metal Mining Energy Efficiency: 1990 to 1994

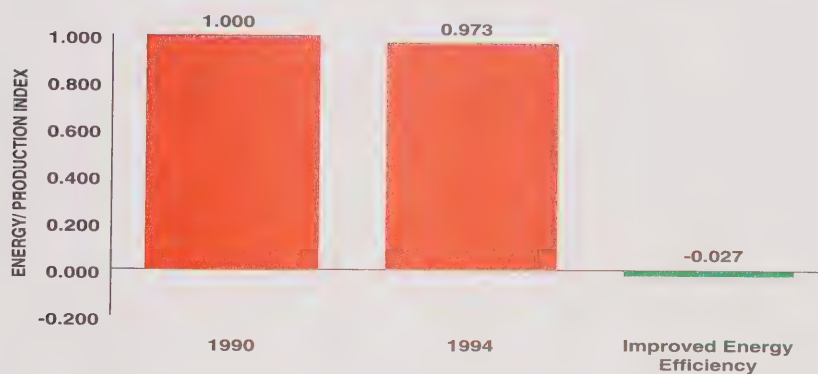
Measure	1990	1994
Total Energy Use (Terajoules)	33,831	37,069
Production (tonnes)	23,070	24,278
Energy / Production (GJ/tonnes)	1.466	1.634
Energy / Production Indexed	1.000	0.973

Source: StatsCan, NRCan, CIEEDAC.

Between 1990 and 1994, the non-metal mining sector increased its energy efficiency by 2.67 per cent. It is expected that next year the potash sector will be reported through a new "Chemical Fertilizer" Task Force.

Figure 32

Non Metal Mining Energy Efficiency: 1990 to 1994



Energy Efficiency by Sector - Tier 1

"New Reporting"

Glass

In 1994, the glass sector consumed 0.5 per cent of total industrial energy.

Negotiations are underway with key members of the glass industry to participate in CIPEC as part of the Industrial Minerals Task Force, to set an annual energy reduction target and to report progress.

Figure 33

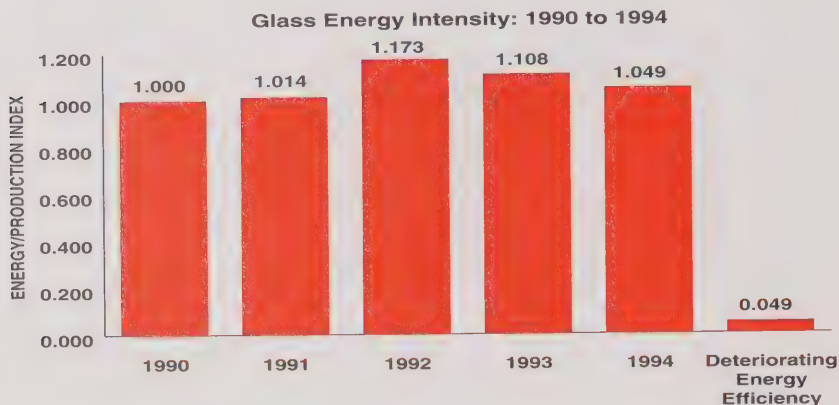
Glass & Glass Products Energy Intensity: 1990 to 1994

Measure	1990	1991	1992	1993	1994
Total Energy Use (Terajoules)	12,105	11,418	14,023	14,440	14,103
Production (GDP '000 '86\$)	572	532	565	616	635
Energy / Production (GJ/\$)	21.17	21.47	24.83	23.43	22.22
Energy / Production Indexed	1.000	1.014	1.173	1.110	1.050

Source: StatsCan, NRCAN, CIEEDAC.

Between 1990 and 1994, the glass sector's energy intensity deteriorated by 4.9 per cent.

Figure 34



Energy Efficiency by Sector - Tier 2 And All Other Sectors

Tier 2 companies and in all other sectors consumed 21 per cent of all industrial energy used in 1994. See Appendix 1 for a list of these sectors. CIPEC has not previously reported on Tier 2 companies because there was no reliable data-base.

Figure 35

Industrial Energy Use by Sector: 1990 and 1994

	1990 Terajoules	% of Total	1994 Terajoules	% of Total	% Change
Tier 1 "Base" Sub Total	1,770,054	68.1%	1,866,468	69.7%	1.6%
Tier 1 "New Reporting" Sub Total	196,777	7.6%	243,132	9.1%	1.5%
All Other Sectors including Tier 2	631,534	24.3%	569,188	21.2%	-3.1%
All Industry	2,598,365		2,678,788		3.1%

Source: StatsCan and Sector Task Forces

Beginning in 1996, CIPEC will be reporting on 13 Tier 2 sectors using the results of the 1995 ICE Survey and the relationships between CIPEC and the trade associations representing Tier 2 companies. (Tier 2 sectors involved are shown in Figure 36.)

Figure 36

Tier 2 Sectors		All Other Industrial Sectors
Breweries Textiles Transportation	Chemical Fertilizers Electrical and Electronics Food Industry • Bakery • Dairy • Fruit and Vegetables • Meat and Poultry Foundries General Manufacturing • Clothing • Furniture • Leather/Allied • Machinery • Printing/Publishing • Tobacco • Metal Fabrication • All other Plastics Rubber Wood Products	See Appendix 1 on page 71

This year partial information is available on only three Tier 2 sectors - breweries, textiles, and transportation - from 1990 to 1993.

Brewery Products

Industry data suggests that, over the four year period 1991 to 1994, a 9 per cent energy efficiency improvement was achieved. The units of measurement for energy efficiency are megajoules of energy per hectoliter of beer produced.

Figure 37, however, is based on StatsCan information and compares total energy use, units of output, the sector's energy efficiency rate, and the overall energy efficiency index from 1990 through 1993.

Brewery Products Industry's Energy Efficiency: 1990 to 1993

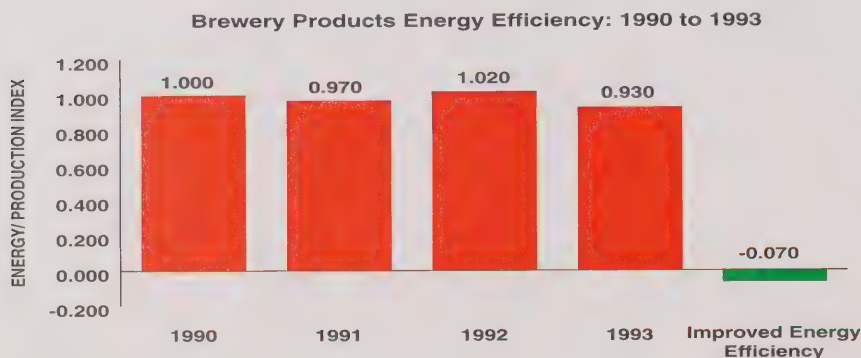
Measure	1990	1991	1992	1993
Total Energy Use (Terajoules)	7,403	7,032	7,222	6,716
Production (Millions of hectolitres [Mhl])	22.6	22.1	21.6	22.1
Energy / Production (MJ/Mhl)	327.6	318.2	334.4	303.9
Energy / Production Indexed	1.000	0.970	1.020	0.930

Source: StatsCan, NRCan, CIEEDAC, Sector Task Force

Figure 37

As Figure 38 illustrates the sector's energy efficiency over this three year period improved by 7 per cent.

Figure 38



Energy Efficiency Commitment: 1995 - 2000

The brewery sector is committed to improving its energy efficiency by 3.0 per cent per unit of output per year for the period 1995 to 2000

The Brewing task force consists of representatives from Labatt, Molson, Moosehead and Sleeman Breweries. Together these companies represent 90 per cent of brewing capacity in Canada.



CIPEC

Energy Efficiency by Sector - Tier 2

Brewery Products

Brewery Task Force

Ralph Backman, Labatt Breweries of Canada, Chairman

Tomas Lom, Molson Breweries

Peter Henneberry, Moosehead Breweries

Al Brash, Sleeman Breweries

Energy Efficiency Initiatives - Brewery Products

In the past year, the industry has undertaken a variety of activities to boost this already strong performance. For example, Labatt has implemented specialized energy opportunity training through CIET (Canadian Industry Energy Training) for all of its brewery managers.

Molson has instituted a pilot monitoring and tracking program in conjunction with Ontario Hydro. Over 125 energy cost centres are involved in one location. Annual energy savings in excess of \$750,000 are being achieved.

Moosehead is participating in the federal On-Site program, a special Unemployment Insurance program, that provides Moosehead with qualified energy management professional for six months at a cost of only \$100 per week, to help draft and install an energy management program.

Textiles

Canada's textile industry has annual sales of over \$8 billion, including the export of product worth more than \$2 billion. The industry includes producers of man-made fibres and filament yarns, spun yarns, fabrics, and a wide range of textile products for the consumer and about 150 customer industries. These include agriculture, automotive, clothing, construction, environmental protection, and road building.

Over the past 15 years the industry has been transformed through substantial and sustained capital investment. While not a significant energy user, the textile industry's annual energy bill is approximately \$200 million.

From 1974 to 1990, the textile industry reduced its energy use per unit of production by 29.8 per cent.. Between 1990 and 1993, however, the industry's energy intensity increased by 11.1 per cent. See Figures 39 and 40.

Figure 39

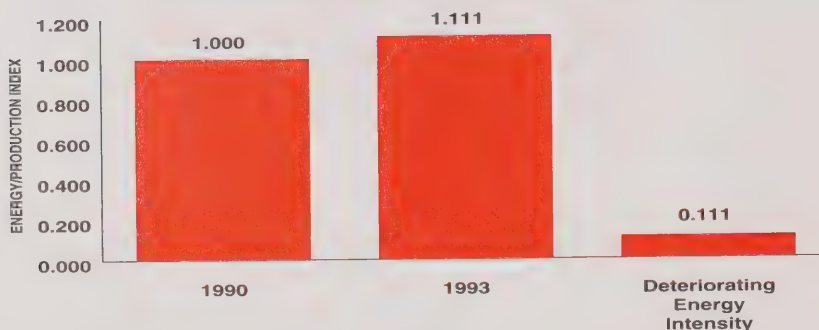
Textile Industry's Energy Intensity: 1990 to 1993

Measure	1990	1993
Total Energy Use (Terajoules)	20,939	21,399
GDP (M '86\$)	1,991	1,831
Energy / Production (GJ/GDP)	10.52	11.69
Energy / Production Indexed	1.000	1.111

Source: StatsCan, NRCan, CIEEDAC, Sector Task Force

Figure 40

Textile Industry Energy Intensity: 1990 to 1993



Energy Efficiency Commitment: 1995 - 2000

The textile sector is committed to improving its energy efficiency by 2.0 per cent per unit of output per year for the period 1995 to 2000.



CIPEC

Energy Efficiency by Sector - Tier 2

Textiles

Textile Energy Task Force

Peter Chantraine, DuPont Canada Inc., Chairman
Eric Barry, Canadian Textile Institute
Abraham Turkson, Albarrie Canada Limited
Jacques Boutin, Consoltex Inc.
Cécile Miclette, Albarrie Environmental Services
Louise Métivier, Natural Resources Canada
Gilles Charron, Dominion Textile Inc.
René Nantel, Peerless Carpet Corporation
Ian Campbell, NRCan
Pierre Beeks, J. L. de Ball Canada Inc.
Roger Leclerc, Centre des technologies textiles
Pierre de Broux, Intech PEM Inc.

Energy Efficiency Initiatives - Textiles

In the past year, the Textile Energy Task Force has:

- set a textile industry energy reduction target of 10 per cent per unit of production for the period 1996 to 2000
- developed an action plan which has been approved by the Canadian Textile Institute's Board of Directors
- invited every company in the industry to become an Industrial Energy Innovator and a participant in Canada's Voluntary Challenge and Registry program
- planned regional workshops for early in 1996 to provide individual firms with the knowledge required to establish energy efficiency programs.

Swift Textiles Inc., Drummondville

Swift Textiles invested \$150,000 in energy efficiency measures, involving little equipment or technical modifications. After one year, energy savings of \$192,300 were achieved. The approach was to obtain the active participation of all hourly paid employees and management and to raise awareness, and importance, of energy conservation in the plant and at home.



CIPEC

Energy Efficiency by Sector - Tier 2

Transportation (Manufacturing)

The Transportation Task Force, established in the early seventies, draws its membership from six associations representing automotive and trucks, automotive parts, aerospace and marine industries.

In 1990, Chrysler, Ford and General Motors consumed 71 per cent of the reported energy used by this sector. Since 1990, in spite of continuing economic uncertainty, in excess of \$7 billion has been invested in new paint and assembly facilities and major retooling by these three companies.

In the automotive parts sector, which accounts for 17 per cent of the energy reported in 1990 for this sector, there has been considerable restructuring, resulting in fewer, but larger companies exporting over 85 per cent of their production to the U.S., Mexico, Europe and Asia.

Figure 41 below compares the industry's energy efficiency for the years 1990 through 1993.

Figure 41

Transportation Industry's Energy Efficiency: 1990 to 1993

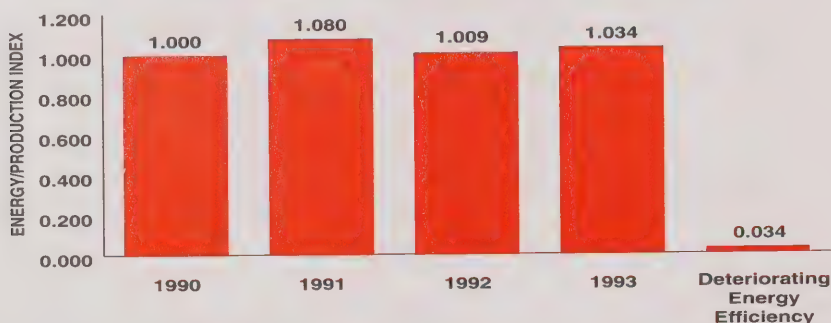
Measure	1990	1991	1992	1993
Total Energy Use (Terajoules)	41,217	41,740	42,856	48,846
Total Vehicles (000 units)	1,748	1,639	1,802	2,003
Energy / Production (GJ/'000 units)	23.58	25.47	23.78	24.39
Energy / Production Indexed	1.000	1.080	1.009	1.034

Source: StatsCan, NRCan, CIEEDAC, MVMA Sector Task Force

In essence, energy efficiency in the transportation (manufacturing) sector deteriorated over the period by about 3 per cent. The automotive sector is highly vulnerable to economic cycles and its performance is generally regarded as a leading economic indicator.

Figure 42

Transportation Energy Efficiency: 1990 to 1993



Energy Efficiency Commitment: 1995 - 2000

The transportation sector is committed to improving its energy efficiency by 1.0 per cent per unit of output per year for the period 1995 to 2000.



Energy Efficiency by Sector - Tier 2

Transportation (Manufacturing)

Transportation Task Force

Ken Rossi, *Ford Motor Co. of Canada, Chairman*
Ralph Davies, *Hayes-Dana*
Thomas Graham, *General Motors*
Dave Cherney, *CAMI*
Mark Cotter, *Automotive Parts Manufacturers' Association*
Peter Corbyn, *Woodbridge Foam*
Paul Hansen, *Chrysler Canada*
Ian Campbell, *NRCan*

Energy Efficiency Initiatives - Transportation

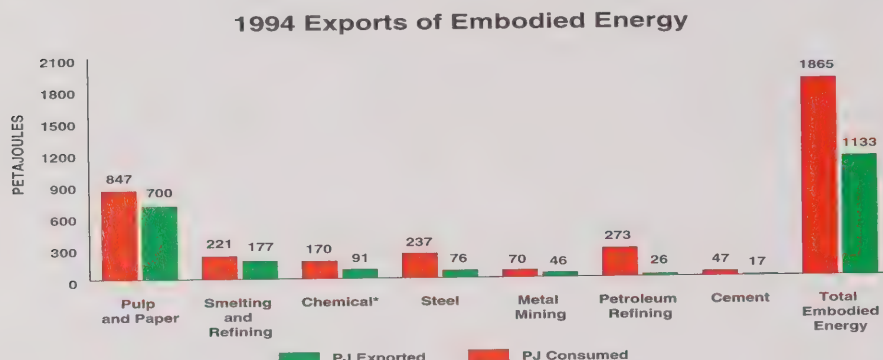
The Transportation sector:

- has broadened its sector membership as a result of its exceptional response to the Industrial Energy Innovator program
- in the coming year will be re-issuing the "Idea Exchange" and promoting energy conferences. The program will be launched initially with examples from the automotive industry where many of the traditional initiatives such as lighting replacement, high efficiency motors, compressor controls, variable speed drives and energy management systems are already in place and proving energy and cost efficient
- will share case studies on insulation, retrofit burners, sand reclamation and, perhaps, most important, process changes in casting operations which enable energy reductions in the machining process
- will encourage companies in the sector which do not have an energy reporting and data analysis system in place to adopt one. The theme will be: "If you can't measure it — you can't manage it".

Exports of Embodied Energy: 1994

Canada is a major exporter, particularly of processed or semi-processed natural resources. As a result, Canada exports a significant amount of the energy used in the production of manufactured or refined products. This is called “embodied energy”.

Figure 43



* Historic and forecast energy use data shown in this report for the chemical sector are based on StatsCan's ICE survey as for other CIPEC sectors. The Canadian Chemical Producers' Association (CCPA) annual Reducing Emissions report covers emissions and projections for all greenhouse gases for all its members. The CCPA methodology does not correspond directly with the energy use data reported by StatsCan.

Seven industrial sectors - pulp and paper, smelting and refining, chemicals, steel, metal mining, petroleum refining, and cement, as a group - exported over 60 per cent of their output in 1994, including 1,133 petajoules of embodied energy.

Unfortunately, these exports of energy are not yet taken into account when comparing one country's energy consumption with another. The usual measurement is per capita consumption of energy. As a result, Canada is frequently characterized as the industrialized world's “energy hog”.

Per capita comparisons which do not take into account embodied energy contained in exports are simplistic and an inaccurate way to compare one country's energy efficiency performance with another.

Rather than measuring per capita consumption, a better measure is the amount of energy used to produce a unit of production. This is a true reflection of energy efficiency.

On this basis, Canadian industrial companies compare very favourably with industries in other countries. For example, Inco's Sudbury Division is the most energy efficient nickel producer in the world. And, on an overall cost of production basis, Falconbridge's Integrated Nickel is the world's lowest cost nickel producer.

Unfortunately, Canada is one of the few jurisdictions which measures energy efficiency per unit of production. Canadian industry must be vigilant that others, including government, do not perpetuate the measurement of energy on a per capita consumption basis.

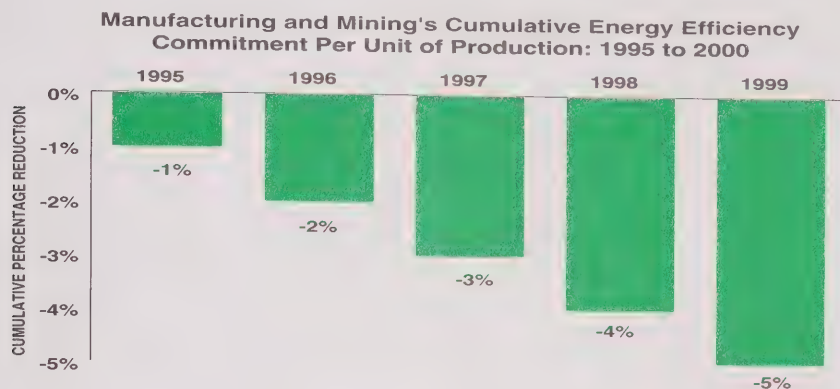


CIPEC

Energy Efficiency Commitment : 1995 to 2000

Canada's industrial companies have committed to a one per cent reduction per year in energy consumption per unit of production between 1995 and 2000, a 5 per cent cumulative reduction over the period.

Figure 44



This commitment is based on a sector by sector evaluation of what is possible by 11 industrial sector task forces.

Energy Reduction Commitment By Sector

Thirteen sectors have established annual energy efficiency improvement targets per unit of production for the period 1995 to 2000.

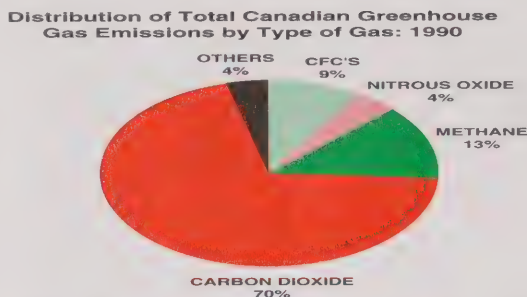
Figure 45

Industrial Sector	Annual Percentage Energy Efficiency Improvement Targets: 1995 - 2000
Brewery	3.0%
Cement	0.7%
Electrical/Electronics	1.0%
General Manufacturing	1.0%
Metal Mining	1.0%
Petroleum Refining	1.0%
Plastics	1.0%
Pulp & Paper	1.0%
Smelting and Refining	1.0%
Steel	1.0%
Textiles	2.0%
Transportation	1.0%
Wood Products	1.0%
Aggregate Commitment	1.0%

Carbon Dioxide and Greenhouse Gas Emissions

Greenhouse gases include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and chlorofluorocarbon (CFC's). Carbon dioxide is the most important greenhouse gas because it accounts for about 70 per cent of the infrared absorption due to all greenhouse gas emissions.

Figure 46



In 1990, Canada contributed about 2 per cent of global carbon dioxide emissions, of these approximately 94 per cent were attributable to the combustion of fossil fuels and, of this, only 20 per cent was attributed to manufacturing and mining companies.

Industry's Carbon Dioxide Emissions Performance: 1990 to 1994

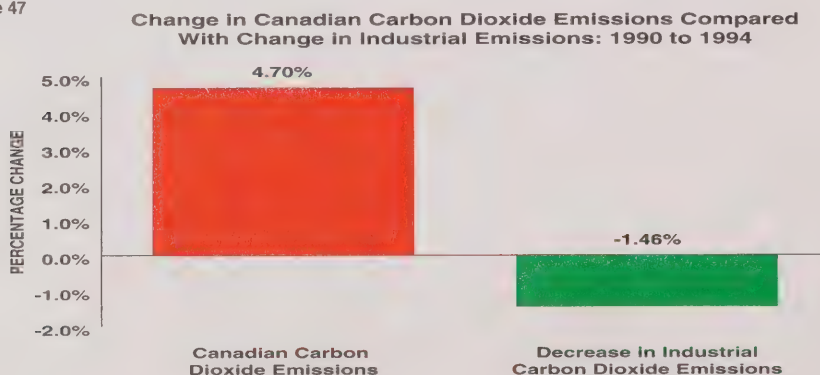
Agreement on the amount of carbon dioxide and other greenhouse gases emitted by industry is an important element of a successful voluntary energy efficiency program. CIPEC is working with Environment Canada, StatsCan, Natural Resources Canada, and CIEEDAC to identify the amount of carbon dioxide emitted by industry.

Environment Canada is responsible for calculating Canada's official carbon dioxide and other greenhouse gas emissions statistics and for maintaining the official inventory.

According to Environment Canada, total carbon dioxide emissions in Canada for all sectors of the economy increased over the period 1990 to 1994 by 4.7 per cent or 21,496 Kilotonnes. Environment Canada's definition of industry includes emissions from energy consumed by industry and the forestry and construction industries.

When forestry and construction are removed from Environment Canada's carbon dioxide statistics, industrial carbon dioxide emissions declined by 1.46 per cent over the period 1990 to 1994, or a total reduction of 1,350 kilotonnes.

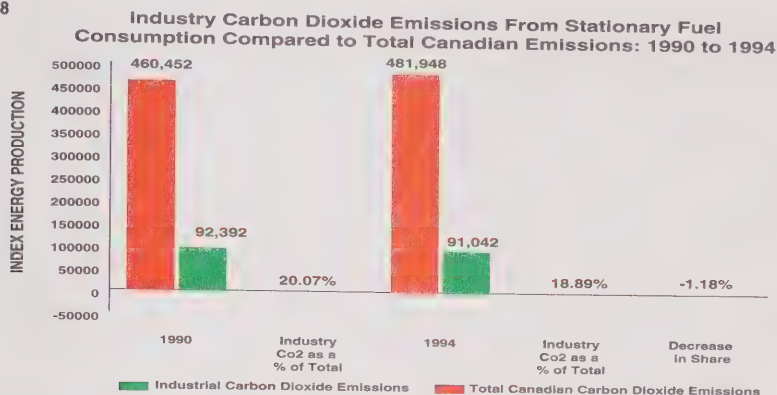
Figure 47



Industry's Carbon Dioxide Emissions Performance: 1990 to 1994

Industry's share of total Canadian carbon dioxide emissions has declined from 20.07 per cent in 1990 to 18.89 per cent in 1994, a decline of 1.18 percentage points.

Figure 48



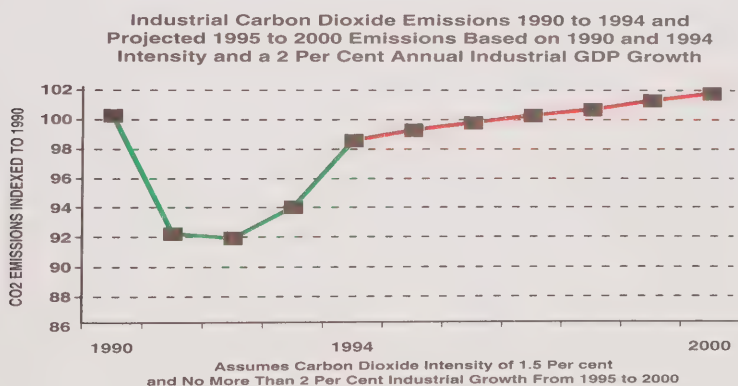
In addition to defining industry differently, Environment Canada does not yet have access to the data collected by the Industrial Consumption of Energy (ICE) Survey. This restricts the accuracy of the data base from which it calculates carbon dioxide emissions.

As well, Environment Canada and CIEEDAC do not calculate emissions in comparable ways. This, too, accounts for differences in CIPEC's carbon dioxide emission data from that of Environment Canada.

These differences are being resolved and there should be complete comparability between CIEEDAC and Environment Canada for 1996 data.

Figure 49 illustrates the decline in industrial carbon dioxide emissions between 1990 and 1994. If the same annual carbon dioxide intensity of 1.5 per cent is maintained between 1995 and 2000, and if the annual industrial GDP growth rate does not exceed 2 per cent, industry's carbon dioxide emissions will exceed 1990 levels in 2000 by 1.6 per cent, if it does not adopt accelerated procedures.

Figure 49



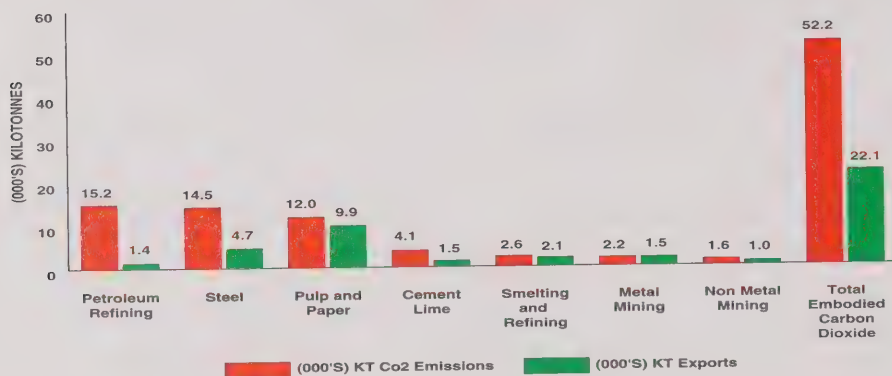
Exports of Embodied Carbon Dioxide

In 1990 industrial carbon dioxide emissions totaled 92,392 kilotonnes. This level decreased to 91,042 kilotonnes by the end of 1994, or 1.46 per cent less.

Figure 50 ranks the principal industrial sources for carbon dioxide emissions in 1994 from stationary sources. Seven industrial sectors - petroleum refining, steel, pulp and paper, cement, smelting and refining and non-metal mining - produced approximately 52 per cent of all industrial carbon dioxide emissions. These seven sectors, as a group, exported 42 per cent of their production, including 22,100 kilotonnes of embodied carbon dioxide.

Figure 50

1994 Exports of Embodied Carbon Dioxide



Source: CIPEC and CIEEDAC (for carbon dioxide emission estimates by sector)

It is CIPEC's view that embodied carbon dioxide should be credited to the account of the importing country for purposes of determining per capita "consumption" of carbon dioxide.



CIPEC

Climate Stabilization: Post 2000

In 1992, with the signing of the United Nations Framework Convention on Climate Change (the Rio Accord), Canada committed to stabilize carbon dioxide emissions at 1990 levels by the year 2000 and to prepare a National Action Program on Climate Change (NAP).

In addition to carbon dioxide stabilization, the United Nations Framework Convention on Climate Change (the Rio Accord) focused on stabilization of other greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system (climate stabilization).

While Canada has not committed to specific climate stabilization targets, the dimensions of the challenge are becoming clearer.

In 1990, the Intergovernmental Panel on Climate Change (IPPC) - a panel of scientists and policy makers from around the world - suggested that climate stabilization would require reducing carbon dioxide emissions to 50 per cent of their 1985 levels by 2050.

The federal Liberal Party's Red Book states that Canada should reduce carbon dioxide emissions 20 per cent from its 1988 levels by the year 2005.

The Rio Accord's climate stabilization goal, notwithstanding, the future of Canada's economy is a shared responsibility of industry and government, just as much as the ensuring of a healthy environment is a shared responsibility.

In April 1995, the Berlin Conference of Parties established a two year process (1995 to 1997) during which international negotiations would be undertaken in an effort to establish new GHG emission reduction targets for the years 2005, 2010 and 2020.

Projecting the Carbon Dioxide Emissions Gap Post 2000

Given this process, a study was commissioned designed to provide a preliminary understanding of the greenhouse gas emissions "gap" which is likely to exist, if any, with respect to four specific reduction targets now being proposed:

- a 20 per cent reduction of CO₂ from 1990 levels by the year 2005 (proposed by AOSIS - Alliance of Small Island States)
- the maintenance of 1990 GHG levels indefinitely after 2000 (proposed by the European Union)
- a 10 per cent reduction of GHG emissions by 2010 (proposed by the UK)
- a 20 per cent reduction in CO₂ emissions from 1988 levels by the year 2005 (page 70, Creating Opportunities: The Liberal Plan for Canada)

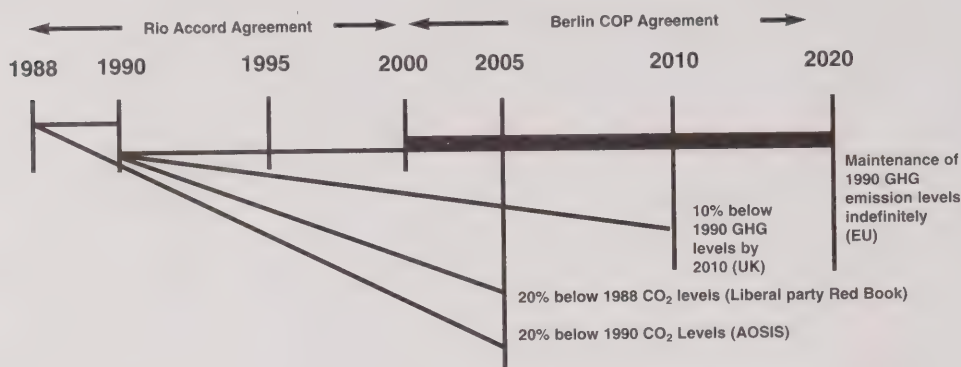
The schematic Figure 51, illustrates the relationship of each of these proposed targets relative to the 1990 base year.

In each case, the study assumed voluntary GHG emission reductions and a "no regrets" - "best efforts" approach, based on cost effective investments and the maintenance of relative competitiveness.

Projecting the Carbon Dioxide Emissions Gap: Post 2000

The study is a preliminary assessment and gives industry leaders in the major energy consuming industrial sectors an appreciation of the GHG emission reduction targets.

Figure 51



To ensure the assumptions used in the study reflect the realities of each industry sector an advisory group (Panel of Experts) was established including:

- economists and/or other representatives from each of major energy consuming industrial sectors:
 - pulp and paper
 - petroleum refining
 - steel
 - chemicals
 - aluminum and non-ferrous
 - mining and metallurgy
 - cement and lime
 - wood products
- representatives from the energy supply industry (oil, natural gas and electricity)
- a representative from NRCan
- a representative from Environment Canada
- a representative from the Business Council on National Issues (BCNI).

The Panel of Experts was requested to provide information on:

- the outlook for overall economic growth, inflation, interest rates, and other relevant indicators for their sectors
- the likely future performance of individual industry sectors
- whether their sector is likely to represent a larger or smaller part of the economy in the future
- likely changes in technology and energy efficiencies in their sector.

Projecting the Carbon Dioxide Emissions Gap: Post 2000

- their views on realistic assumptions about the plans of Canada's major trading partners as they relate to their sectors.

Key Assumptions

Dr. Ernest Stokes, Stokes Economic Consulting, was responsible for the study. The following actual and projected GDP growth rates and energy intensity rate assumptions were used in the study.

Figure 52

Actual and Projected Industrial Growth/Carbon dioxide GDP:

Study Assumptions	Actual 1991 - 1994	Projection 1995 - 2000	Projection 2001 - 2010
Consensus Growth	1.3%	3.1%	2.3%
Consensus Carbon dioxide Intensity	-1.5%	-0.8%	-0.8%
Low Growth	1.3%	2.1%	1.3%
Low Growth Carbon dioxide Intensity	-1.5%	-0.7%	-0.7%
High Growth	1.3%	4.3%	3.3%
High Growth Carbon dioxide Intensity	-1.5%	-1.0%	-1.0%

In addition it was agreed that:

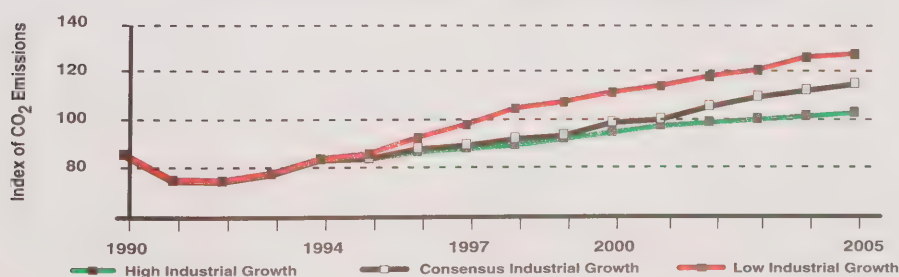
- industry would introduce new technology only when it is economic
- industrial carbon dioxide is defined as emissions originating from fuel consumption from stationary sources and from process carbon dioxide emissions. No industrial electricity use is included.

Study Findings

Figure 53 illustrates the projected carbon dioxide emissions based on the consensus assumptions, a high case and a low case.

Figure 53

Carbon Dioxide Emission Projections: 1995 to 2005



Projecting the Carbon Dioxide Emissions Gap: Post 2000

Study findings: Carbon dioxide emissions

Post 1995, a carbon dioxide intensity reduction of 0.8 per cent per year is more likely than the 1.5 per cent experienced from 1990 to 1994. Given this, the projected carbon dioxide gap for each of the three cases is set out in Figure 54.

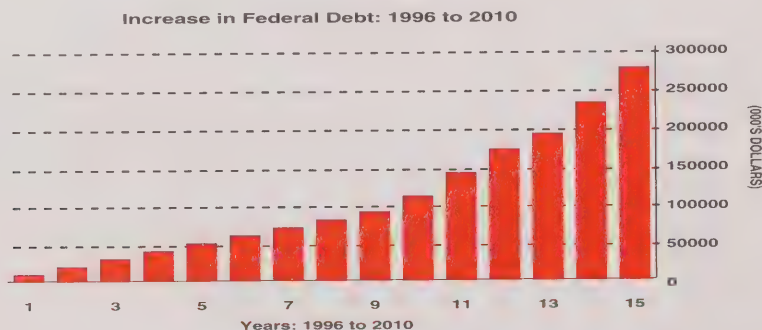
Figure 54

1995 to 2000	Low case		Base case		High case	
	GDP	Carbon dioxide Intensity	GDP	Carbon dioxide Intensity	GDP	Carbon dioxide Intensity
	2.1%	-0.7%	3.1%	-0.8%	4.1%	-1.0%
	Carbon dioxide gap		13%		19%	
2001 to 2005	Low case		Base case		High case	
	GDP	Carbon dioxide Intensity	GDP	Carbon dioxide Intensity	GDP	Carbon dioxide Intensity
	2.1%	-0.7%	3.1%	-0.8%	4.1%	-1.0%
	Carbon dioxide gap		22%		33%	
2006 to 2010	Low case		Base case		High case	
	GDP	Carbon dioxide Intensity	GDP	Carbon dioxide Intensity	GDP	Carbon dioxide Intensity
	2.1%	-0.7%	3.1%	-0.8%	4.1%	-1.0%
	Carbon dioxide gap		31%		50%	

Study Findings: Federal Debt Growth

Federal debt is projected to grow by \$270 billion between 1996 to 2010 if Canada reduces industrial output to the low growth case in order to reduce carbon dioxide emissions to a level which is still 15 per cent above 1990 levels.

Figure 55

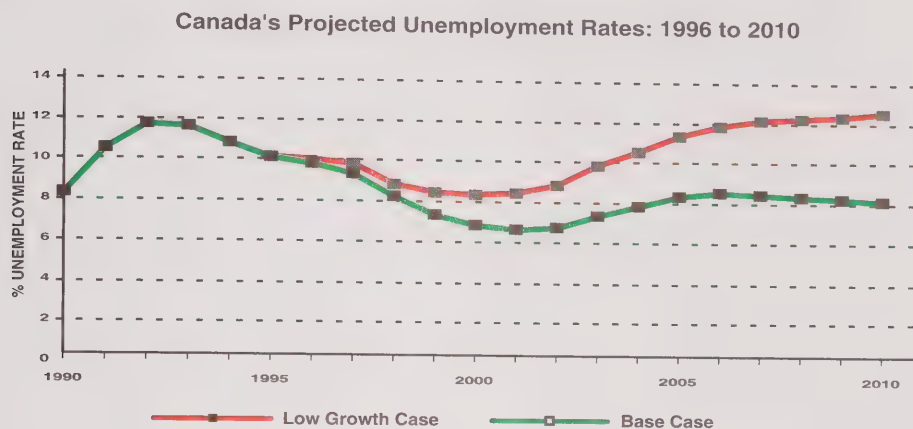


Projecting the Carbon Dioxide Emissions Gap: Post 2000

Study Findings: Unemployment Rate

Unemployment is projected to increase to 12.3 percent by 2010 if Canada reduces industrial output to the low growth case in order to reduce carbon dioxide emissions to a level which is still 15 per cent above 1990 levels.

Figure 56



Study Conclusions

- Even if industry's carbon dioxide emission intensity continues at 1.5 per cent per year beyond 2000, industrial GDP could not grow more than 1.5 per cent a year in order to maintain carbon dioxide emissions at 1990 levels
- If Canada agrees to carbon dioxide (GHG) emission targets below 1990 levels, it will require, either:
 - significantly lower annual industrial GDP growth rates, with attendant unemployment, increased government debt, and/or reduced government spending, or
 - compensating reductions in carbon dioxide emissions by other sectors of the economy: residential, transportation, commercial, agriculture, etc.
- Three of the four proposed targets - (i.e., AOSIS, federal Liberal Party and the UK proposal) - for reduced carbon dioxide / greenhouse gas emissions beyond 2000 can be achieved only if Canada experiences negative industrial GDP growth

The fourth target (EU) can be achieved only with an annual industrial GDP growth rate of less than 1 per cent

- Canada should not agree to more stringent annual or short term greenhouse gas emission targets beyond 2000.

Projecting the Carbon Dioxide Emissions Gap: Post 2000

Study Conclusions

- Industrial energy users, provinces, the federal departments of Finance, NRCan, Environment, Industry, and Foreign Affairs must coordinate their efforts in developing Canada's negotiating position on new greenhouse gas emission targets post-2000
- Industry has a responsibility to seek out all "no regrets" opportunities which would reduce energy consumption and related GHG emissions between 1995 and 2000.

In view of the foregoing, it appears as though greenhouse gas emission targets are as much an economic, trade, jobs, standard of living, issue as it is an environmental issue. As such, Canada cannot afford to treat these international GHG negotiations as a single item agenda.

As well, even if the GDP growth rate projections were halved and the carbon dioxide intensity rates were doubled, it still would not be possible to meet the four proposed reduction targets.

Proposed next steps

- Industry should establish a mechanism to present to government at the highest level the implications to Canada of more stringent greenhouse gas emission targets post 2000



CIPEC Services To Industry

Canadian industry, through CIPEC, works with government and other stakeholders in a voluntary initiative to improve energy efficiency and, thereby, to improve industrial competitiveness and help achieve Canada's greenhouse gas emission stabilization goals.

CIPEC provides a variety of services to industry, including:

- establishment of accurate and reliable baseline data collection and tracking systems
- supporting industry establish voluntary, sector by sector energy efficiency improvement targets and track progress towards those goals
- identifying opportunities for technology transfer
- the Industrial Energy Innovator initiative
- energy efficiency training through the Canadian Institute for Energy Training (CIET)
- energy management personnel available through On-Site.

On-Site is an initiative supported by the federal government whereby an unemployed professional, with appropriate background and experience, is chosen by a company to go "on staff but not on payroll" for a six month in-house energy management training experience. During this period, he/she receives unemployment insurance.

More than 35 percent of these workers go on permanent staff at the end of the training period and more than two-thirds of them are ultimately employed by others.

- representing industry views, for instance, before the Ontario Energy Board, the Climate Change Task Group, the Natural Gas Externalities Collaborative, and at natural gas utility Demand Side Management consultative meetings.
- an updated Guide on Energy Management for industry
- services of an industrial technology advisor to assist companies or task forces with their energy efficiency problems
- developing industrial energy efficiency case histories
- arranging for Energy Performance Contracting assistance, including third party, off-balance sheet energy efficiency investment financing
- providing monthly industrial energy efficiency news and information in "Plant" newspaper
- regular information exchange with governments, utilities and others on energy efficiency issues, thereby ensuring the energy efficiency activities of these organizations are better coordinated.



CIPEC Services To Industry

Benefits to Companies Participating in CIPEC

Industry benefits from CIPEC as a result of:

- a coordinated, voluntary industry response to a government priority, such as the Voluntary Challenge and Registry
- a single focus for industry action rather than a company having to appoint representatives to a multitude of association energy committees all trying to attain the same goal
- ensuring accurate, credible and cost-effective data gathering on behalf of industrial sectors
- providing credible analysis of data through CIEEDAC
- a strong industry voice for realistic solutions to complex energy efficiency issues
- annual recognition of industry achievement through Industrial Energy Innovator awards and the CIPEC annual report.

Benefits to Industry Associations from Participating in CIPEC

Industry associations benefit from participation in CIPEC because:

- CIPEC complements industry association mandates to safeguard the interests of their members
- in an era of financial restraint, CIPEC avoids needless duplication of effort
- an industry association can appoint a sector representative to the CIPEC Policy Board and Task Force Council, thereby ensuring its sector's perspectives are taken into account
- CIPEC ensures that the accurate measurement of industrial progress is achieved in a cost-effective way.



CIPEC

CIPEC Services To Industry

Group ISO 9000 Program with Energy Efficiency Performance Measures

To assist small to medium sized manufacturers (SME's) become more energy efficient, CIPEC in cooperation with Ontario Hydro, Consumers Gas, Union Gas, Centra Gas, the Ontario Ministry of Environment and Energy and NRCan have initiated a unique program to identify and then measure energy efficiency performance measures.

SME's use about 8 per cent of the energy consumed by Canadian industry, or about 2 per cent of Canada's total annual energy consumption.

Considering that there are thousands of SME's in Canada, the amount of energy any one company uses is small. But energy costs money and anything which can be done to reduce the amount used per unit of production improves the corporate bottom line.

As well, energy related greenhouse gas emissions, such as carbon dioxide, are of increasing concern to governments, so every effort is being taken to reduce the amount of energy consumed by industry, regardless of size.

Energy, as traditionally defined, is not usually a major operating cost for most SME's. As a result, energy efficiency projects are not usually assigned high priority.

A 1994 Canadian Manufacturers' Association survey suggests, for example, that:

- 79 per cent of manufacturing companies with sales of less than \$10 million do not have an energy efficiency program in place, and that
- 61 per cent of all manufacturers, regardless of size, do not have an energy efficiency program in place.

For most companies, it is difficult to measure accurately all of the primary and secondary energy, water and other resources consumed in the manufacturing process.

With these considerations in mind, CIPEC has initiated a pilot project which links implementation of ISO 9000 quality assurance standards to energy efficiency performance measures.

The objective is to enable participating companies to identify ways to reduce the amount of energy and other scarce resources used to produce a unit of production and, thereby, to enhance their competitive position. As well, each company achieves compliance with an ISO 9000 standard.

While costs related to lack of quality are usually thought to be 3% to 5% of operating expenses, a comprehensive economics of quality approach is able to show that real energy costs are usually significantly higher.

ISO 9000 provides a framework within which key processes within an organization can be identified and documented.

Organizations employing this approach can justify energy efficiency investments since paybacks are clearly identified at both an operating and strategic level.

The participating companies, representing diverse industrial sectors, are:

Figure 57

Participating Companies

MCM Nor County Frozen Food, Port Hope, Ontario
 PaintPlas (1998) Inc., Ajax, Ontario
 Thermal Ceramics, Burlington, Ontario
 Uniropo Ltd., Mississauga, Ontario
 Alumatic Ltd., Rexdale, Ontario

Products

frozen vegetables
 painted autoparts
 insulation
 wire and slings
 aluminum doors and windows

Energy is broadly defined to include natural gas, electricity, oil, energy embodied in materials used in the manufacturing process, and water (both process and non-process).

Over a 12 month period, these five companies will implement a quality system meeting all of the requirements of ISO 9002 (1994), plus 3 enhancements:

- energy related economics of quality
- delivery performance
- communication with the customer

How it Works

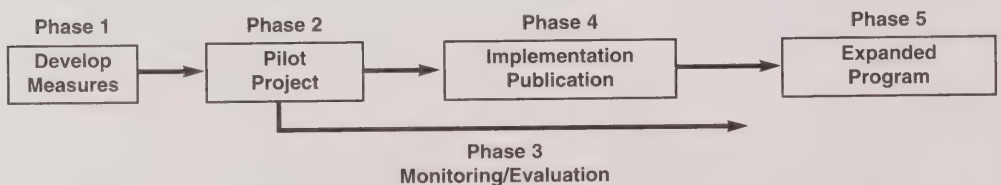
Each company sends up to three representatives to each monthly training session meeting. At the beginning of the program, they were benchmarked against the ISO 9002 (1994) standard. In addition, each company receives a total of ten one-on-one consulting days over a 12 month period.

The implementation part of the program is conducted in a classroom setting once a month over 12 months. Two to three sections of ISO 9002 (1994) are covered at each session, with specific assignments being given to each company for completion before each subsequent session. Classroom instruction takes place in a central location.

At the end of the 12 month period, each company will be audited again against ISO 9002 (1994), using the checklist of the registrar selected by that company.

For an SME, this Group ISO 9000 program with the energy efficiency performance standards achieves two important objectives. First, it helps them implement an ISO 9000 system and achieve registration. Second, it enables companies to identify and control energy and other resource costs.

Figure 58





1995 International Industrial Energy Efficiency Conference

On November 10, 1995, CIPEC sponsored its second International Industrial Energy Efficiency Conference. Over 150 leading executives from Canadian industry attended.

The Minister of Natural Resources Canada, the Honourable Anne McLellan, outlined the federal government's expectation of industry and recognized over 170 Industrial Energy Innovators.

Speakers from Holland, Denmark, the United States and Canada discussed the response to the Climate Change Challenge in their countries.

A highlight of the program was a presentation by Arthur Sawchuk, President and CEO, DuPont Canada, on the projected impact of tougher greenhouse gas emission targets in the post 2000 period on the Canadian economy.

Tom Kierans, President, C.D. Howe Institute, summarized the Conference findings.

The Minister of Environment and Energy for Ontario, the Honourable Brenda Elliott, also addressed the Conference.

Planning is currently underway to hold another International Industrial Energy Efficiency Conference in 1996.



CIPEC



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Appendices

1. CIPEC Industrial Sectors - Standard Industrial Classification (SIC) Codes	69
2. Industrial Consumption of Energy (ICE) Survey Form	77
3. Industrial Energy Innovators - By Sector	78
4. Recording Industry's Progress	81
5. Sample Letter of Cooperation	84



Appendix 1

CIPEC

CIPEC Industrial Sectors - Standard Industrial Classification (SIC) Codes For Industry

Figure 59 identifies the Standard Industrial Classification (SIC) codes for industry and groups those industrial sectors for which energy use data is collected and reported upon by CIPEC and those which are not.

For 1994, energy consumption data was available for only some industrial sectors, representing about 79 per cent of total industry energy consumption. These are mainly the Tier 1 sectors.

However, for the remaining sectors, detailed 1994 energy consumption data is not available, only a combined total. Some 1993 information is available on some of these sectors from the Annual Survey of Manufacturers (ASM).

StatsCan give a confidence level of more than 90 per cent on the data collected by its ICE survey.

For 1995 data, which will be collected in 1996, the ICE survey will go out to 1936 establishments in all sectors in the CIPEC universe of companies. For purposes of this report, industrial companies are grouped into four categories: Tier 1 "Base"; Tier 1 "New Reporting", Tier 2 sectors and all other sectors on which energy use data is collected but on an aggregated basis.

Figure 59

Tier 1 "Base" 1994 Data ICE Survey by SIC Code		Tier 1 "Base" 1995 Data ICE Survey by SIC Code	
Tier 1 Industry Sectors	SIC Number	Tier 1 Industry Sectors	SIC Number
Aluminum	2951	Aluminum	2951
Other Non-Ferrous Smelting and Refining	2959	Other Non-Ferrous Smelting and Refining	2959
Cement/Lime	3521, 3581	Cement, Lime, Glass	3521, 3581, 3561
Chemicals	3711, 3712, 3731	Chemicals	3711, 3712, 3731
Metal Mining	611, 612, 613, 614, 615, 616, 617, 619	Metal Mining,	611, 612, 613, 614, 615, 616, 617, 619, 2959
Petroleum Refining	3611	Petroleum Refining	3611, 0712
Pulp & Paper	2711, 2712, 2713, 2714, 2719	Pulp & Paper	2711, 2712, 2713, 2714, 2719
Steel	2919	Steel	2919

Tier 1 "New Reporting" 1994 Data ICE Survey by SIC Code		Tier 1 "New Reporting" 1995 Data ICE Survey by SIC Code	
Chemical Fertilizers	3721	Chemical Fertilizers	3721
Glass	3561		
Non-Metal Mining	621, 624, 625, 629	Non-Metal Mining	621, 622, 623, 624, 625, 629
Oil Sands/Upgrader	0712	Oil Sands/Upgrader	0712



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Appendix 1

Tier 2 Sectors Annual Survey of Manufacturers 1993		Tier 2 Sectors 1995 Data ICE Survey by SIC Code	
Tier 2 Industry Sectors	SIC Number	Tier 2 Industry Sectors	SIC Number
Bakery	107	Bakery	107
Brewery Products	1131	Brewery Products	1131
Dairy	1041, 1042	Dairy	104
Electrical & Electronics	33	Electrical & Electronics	33
Iron Foundries	2941		
Fruit and Vegetables	103	Fruit and Vegetables	103
General Manufacturing		General Manufacturing	
• Tobacco	1200	• Tobacco	1200
• Leather/Allied	1700	• Leather/Allied	1700
• Clothing	2400	• Clothing	2400
• Furniture	2600	• Furniture	2600
• Printing/Publishing	2800	• Printing/Publishing	2800
• Machinery	3100	• Machinery	3100
• Metal Fabrication	3000	• Metal Fabrication	3000
• All other	3900	• All other	3900
Glass	3561	Glass	3561
Meat and Poultry	101	Meat and Poultry	101
Plastics	16	Plastics	16
Rubber	15	Rubber	15
Textiles	1811, 1821, 1829, 1831, 1911, 1912, 1921, 1931, 1991, 1992, 1993, 1994, 1995	Textiles	1800, 1900, 3257
Transportation, Motor Vehicles & Parts	3231, 3253, 3254, 3255, 3257, 3289	Transportation, Motor Vehicles & Parts	3231, 3253, 3254, 3255, 3289
Wood Products	2512, 2522, 2592	Wood Products	2500, 2512

Appendix 1

All Other Manufacturing and Mining Sectors on Which Energy Use Data is Collected but on an Aggregated Basis

Sector	SIC Number	Sector	SIC Number
Aluminum Rolling Products	2961	Peat Mining	0622
Feed Mills	1053	Coal Mining	063
Gypsum Mining	0623	Fish Products	102
Other Food Products	1901, 1092, 1093	Flour, Prepared Cereal, Feed	105
Petroleum Lubricants	3612	Other Food Products	109
Railway Rolling Stock	3261	Soft Drinks	111
Shipbuilding	3272	Distillery	112
Sugar and Confectionery	108	Wine	114
Vegetable Oil Mills	1061	Asphalt Roofing	272
Paper Box and Bag	273	Other Converted Paper Products	279
Ferro Alloys	2911	Steel Foundries	2912
Steel Pipe and Tube	292	Copper Rolling, Casting, Extruding	296
Other Non Ferrous	299	Aircraft	321
Truck and Bus Body	324	Engines and Parts	3251
Wiring Assembly	3252	Plastic parts	3256
Other Motor Vehicle accessories and parts	3259	Boat building	328
Other transportation equipment	329	Clay Products	351
Concrete Products	354	Ready mix Concrete	355
Glass Products (ex containers)	3562	Abrasives	357
Other Non-metallic minerals	359	Lubricating oils and greases	3612
Other Petroleum and Coal Products	369	Mixed Fertilizer	3722
Other agricultural products	3729	Paint and Varnish	375
Soap and Cleaning Compounds	376	Toilet Preparations	377
Other Chemical Products	379		

Industrial Consumption of Energy (ICE) Survey 1995

Set out below is an outline of the kind of data collected by the ICE survey.

Purpose of Survey

The purpose of this survey is to obtain information on the supply of, and demand for, energy in Canada. This information serves as an important indicator of Canadian economic performance, is used by all levels of government in establishing informed policies in the energy area. In the case of public utilities, it is used by governmental agencies to fulfill their regulatory responsibilities. The private sector also uses this information in the corporate decision-making process.

Confidentiality

StatsCan is prohibited by law from publishing any statistic which would provide information obtained from this survey that relates to any identifiable business, without the previous written consent of that business. The data reported will be treated in strict confidence, used for statistical purposes and published in aggregate form only. The confidentiality provisions of the Statistics Act are not affected by either the Access to Information Act or any other legislation. An exception to this general rule of confidentiality is the disclosure, at the discretion of the Chief Statistician, of identifiable information relating to public utilities. This includes enterprises supplying petroleum products by pipeline, and enterprises supplying, transmitting or distributing gas, electricity or steam.

Data Sharing Agreements

To reduce the response burden and to ensure uniform statistics, StatsCan has entered into agreements with various agencies and government departments for the joint collection and sharing of data. The information provided in this survey pertaining to individual respondents cannot be divulged, in any way, by the parties with which StatsCan has agreements. Under Section 12 of the Statistics Act, agreements shall not apply to your return if an officer of your company objects in writing to the Chief Statistician and mails the letter to the Industry Division of StatsCan together with the completed questionnaire.

Completion and Return

Complete and return within 30 days after the end of the reporting period. If you require assistance in the completion of the questionnaire, contact the Energy Section at (613) 951-3522.

Certification

I certify that the information contained herein is complete and correct to the best of my knowledge and belief.

Signature _____

Name of Signer (please print) _____

Official position of signer _____

Name of contact for further information: _____

Telephone () _____ Fax () _____



Appendix 2

Industrial Consumption of Energy (ICE) Survey 1995

Industrial Consumption of Energy Survey Guide

I. Reporting Instructions

Please report all energy purchased and/or consumed by the industrial establishment. Exclude energy used by contractors and suppliers and for transportation.

For further details on the energy forms, please refer to Energy Forms on page 4.

Coal, Coke and Heavy Fuel Oil: Report volumes purchased and volumes consumed during the period, and inventory at the start and end of period.

Middle Distillates, Natural Gas, Steam, Electricity, Propane and Refuse: Report the volume consumed during the period only.

Wood and Spent Pulping Liquor: Report the volumes consumed during the period irrespective of whether purchased or from plant source.

Other: Report the energy form, the natural unit, the energy content and the volumes consumed during the period.

If the fuel is used to generate steam for sale then report Steam Sales on the front part of the form.

II. Reporting Units

Please report in metric units (to the closest whole unit). The following conversion factors are provided to assist in the completion of the questionnaire.

Coal, Coal Coke, Petroleum Coke, Wood and Spent Pulping Liquor:

Mg = 1 metric tonne = 2,205 pounds

1 (short) ton = 2,000 pounds

To convert short tons to metric tonnes multiply by 0.90719

Middle Distillates, Heavy Fuel Oil, Refuse and Propane:

m³ = 1 cubic metre = 1,000 litres

1 cubic metre = 220 gallons

1 barrel = 34.97 gallons

To convert gallons to cubic metres multiply by 0.004546 To convert barrels to cubic metres multiply by 0.15891

Natural Gas:

103m³ = 1,000 cubic metres

1 cubic metre = 35.3 cubic feet

To convert cubic feet to cubic metres multiply by 0.02833

Steam Purchased or Sold

Gj - Gigajoule = 1,000,000,000 joules

1 Gj = 948,213 BTU's

To convert 1,000 BTUs to Gj multiply by 0.001 055

To convert 1,000,000 BTUs to Gj multiply by 1.055

Electricity Purchased:

MWh = megawatt hours = 1,000 kilowatt hours (Kw.h)

Industrial Consumption of Energy Survey Guide

III. Definitions

Please report your energy use according to the following definitions:

(a) Reporting Categories

Energy Content - The factor which converts the energy form from its natural unit to a joule scale on a higher heating value basis (except for Refined Petroleum Products).

Opening Inventory - The quantity of the energy form held at the beginning of the reporting period.

Received During Quarter - Energy purchased or received from outside the plant location. Include energy received from an affiliate company.

Produced Internally - Energy produced by the establishment for its own consumption or for resale.

Sales, Adjustments, Losses - Sale of the energy form to a user outside the plant. The user might be an affiliate or a third party. Adjustments include cyclical billing and timing differences, losses in transportation and metering differences.

Consumed to Produce Steam for Sale - Energy consumed in the production of steam which is then sold to a user outside the plant location.

Consumed to Produce Electricity - Energy consumed in the production of electricity which is then sold to a user outside the plant location.

Consumed as Fuel - The quantity of energy consumed in the production process of the plant.

Consumed for Non-Fuel Use - Energy consumed for uses other than as fuel in the plant production process. This includes products used as petro-chemical feedstock, anodes/cathodes, greases, lubricants, etc.

Closing Inventory - The quantity of the energy form held at the end of the reporting period.

(b) Energy Forms

Bituminous Coal - A dense, black coal, often with well-defined bands of bright and dull materials, with a moisture content usually less than 20 per cent.

Subbituminous Coal - A black coal used primarily for thermal generation with moisture content between 15 and 30 per cent.

Lignite - A brownish-black coal of low rank containing 30 to 40 per cent moisture and volatile matter (also known as brown coal).

Anthracite - A hard, black, lustrous coal containing a high percentage of fixed carbon, a low percentage of volatile matter and little moisture content.

Coal Coke - A hard, porous product made from baking bituminous coal in ovens at high temperatures.

Industrial Consumption of Energy Survey Guide

Petroleum Coke - A residue that is the final product in the condensation process in cracking. Includes pitch.

Wood - Wood and wood energy used as fuel, including round wood (cord wood), limb wood, wood chips, bark, sawdust, forest residues, charcoal and pulp waste.

Spent Pulping Liquor - A by-product of the paper making process containing carbohydrate and lignite decomposition products.

Refuse - Solid and liquid waste materials used as a combustible energy source. This would include wastepaper, packing materials, garbage, bagasse, sewerage gas, the burning of contaminants and other industrial, agricultural and urban refuse used to generate electricity for distribution.

Propane - A normally gaseous straight-chain hydrocarbon extracted from natural gas or refinery gas streams. It can also take a liquid form.

Diesel - All grades of distillate fuel used for diesel engines including low sulphur content (with sulphur content lower than 0.05%). Does not include diesel used for transportation on the plant site.

Other Middle Distillates - Includes light fuel oil (nos. 1, 2 and 3), kerosene, mineral lamp oil, stove oil, furnace fuel oil, gas oils and light industrial fuels.

Heavy Fuel Oils - All grades of residual type fuels including low sulphur for steam and diesel engines. Includes fuel oils nos. 4,5 and 6.

Natural Gas - A mixture of hydrocarbons (principally methane) and small quantities of various hydrocarbons existing in the gaseous phase or in solution with crude oil in underground reservoirs.

Steam - A gas resulting from the vapourization of a liquid or the sublimation of a solid, generated by condensing or non-condensing turbines.

Electricity - A form of energy emanating from the movement of positive or negative electric particles accompanied by observable effects as the production of heat, of a magnetic field or of chemical transformations.

Other - Any energy forms consumed not otherwise specified in the questionnaire.

Iron and Steel

Coke Oven Gas - The difference between the thermal value of coal charged to coke ovens less the thermal value of the resultant coke production, with an allowance for heating and losses.

Coal Tar - Organic material separated from coke oven gas evolved during coking operations. A black, viscous liquid including pyridine, tar acids, naphthalene, creosote oil and pitch.

Light Oil - Condensable products (primarily benzene, toluene, xylene and solvent naphtha) obtained during distillation of the coke oven gas, following removal of the coal tar.

Appendix 2

Industrial Consumption of Energy (ICE) Survey 1995

Industrial Consumption of Energy Survey Guide

Refined Petroleum Products

CO₂ Factor - The factor used to measure the emission of CO₂ in the atmosphere per unit of fuel burned.

Petroleum Coke - Grades of coke produced in delayed or fluid cokers that may be recovered as relatively pure carbon.

Coke on Catalytic Cracking Catalyst - Coke produced from the refining process of breaking down the larger, heavier, and more complex hydrocarbon molecules into simpler and lighter molecules.

Refinery Gas - The remaining unseparated gaseous fractions produced in refinery distillation or cracking processes, after marketable products have been extracted, usually consumed as refinery fuel. It is also known as still gas.

Appendix 2 Industrial Consumption of Energy (ICE) Survey 1995

Energy Form	Energy content (gigajoule per natural unit)	Opening Inventory	Received during period	Produced Internally	Sales, adjustments, losses, etc. (please specify below)	To produce steam for sale	In production of electricity	As fuel	For non-fuel use	Closing Inventory
Solids (in metric tonnes)										
Canadian Coal - Bituminous	2.1									
Subbituminous	2.2									
Lignite	2.3									
Foreign Coal - Anthracite	2.4									
Bituminous	2.5									
Coal Coke - Canadian	3.1									
Foreign	3.2									
Petroleum Coke - Canadian	4.1									
Foreign	4.2									
Wood - (hog fuel, wastewood, bark, etc.)	5.0									
Spent pulping liquor	6.0									
Refuse	7.0									
Liquids (in cubic metres)										
Propane	8.0									
Middle distillates - Diesel	9.1									
Other (light fuel oil, kerosene)	9.2									
Heavy (residual) Fuel oil Canadian	10.1									
Foreign	10.2									
Natural Gas (in thousands)	11.0									
Steam (in gigajoules)	12.0									
Electricity (in megawatt hours)	13.0									
Other (Please specify)	14.0									



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Appendix 3

Industrial Energy Innovators - By Sector

There are 178 Industrial Energy Innovators registered with CIPEC (and Natural Resources Canada's Voluntary Challenge Registry) as at December 15, 1995, as follows:

These companies have committed to submit a letter to CIPEC confirming that they will:

- implement energy efficiency measures that make good economic sense
- review energy efficiency performance at least annually
- furnish a brief annual review of its successes and/or achievements using a special CIPEC form designed for this purpose.

Aluminum

Alcan Aluminium Ltd.
Aluminerie de Becancour Inc.
Aluminerie Luralco Inc.
Reynolds Limited

Chemicals

Canadian Electrolytic Zinc Limited
DuPont Canada Inc.
Harcros Pigments Canada
Nacan Products Limited
Synergistics Industries Ltd.

Food and Beverage

Andres Wines
Coca-Cola Beverages
Labatt Breweries of Canada
Molson Breweries

General Manufacturing

3M Canada Limited
ABCO Property Management Inc.
Block Drug Company
Canadian Uniform Limited
Champion Feed Services Ltd.
Coyle & Greer Awards Canada Ltd.
Crown Cork & Seal Canada Inc.
Duracell Canada Inc.
Envirogard Products Ltd.
Euclid-Hitachi Heavy Equipment
Federated Co-operatives Ltd.
Garland Commercial Ranges Ltd.
Greif Containers Inc.

Cement

ESSCROC Canada Inc.
Lafarge Canada Inc.
North Star Cement
St. Lawrence Cement
St. Mary's Cement
Corporation
Tilbury Cement Ltd.
Inland Cement

Electrical/Electronic

Broan Limited
Gould Shawmut Company
Honeywell Limited
Osram Sylvania
Vansco Electronics Ltd.

Food and Beverage

H. J. Heinz Company of Canada
Moosehead Breweries Ltd.
Sleeman Brewing & Malting Co.
Sun-Rype Products Ltd.

General Manufacturing

Kodak Canada Inc.
Kindred Industries
LePage
Maksteel Service Centre
Meridian Clemer Industries Limited
Metroland Printing, Publishing
Oetiker Limited
Polytainers Inc.
Polywheels Manufacturing Limited
PRO-ECO Limited
Renfrew Tap Limited
Simmons Canada Inc.
Starcan Corporation



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Appendix 3

Industrial Energy Innovators - By Sector

General Manufacturing

Huls Canada Inc.
Imperial Wallcoverings
Ingram & Bell Inc.
Interface Flooring Systems
International Paper Industries Ltd.
Jones Packaging Inc.
Morton International Ltd.

Minerals

Chemical Lime Company of Canada
Continental Lime Ltd.

Mining

Aur Resources
Barrick Gold Corporation
BHP Diamonds Inc.
Brunswick Mining & Smelting
Brunswick Smelting & Fertilizer
Cominco
Falconbridge Ltd.
Fonderie Home - Noranda
Placer Dome Canada Ltd.

Petroleum Refining

Canadian Tire Petroleum
Chevron Canada Limited
Husky Oil Corporation
Imperial Oil
Irving Oil Limited
Novacor Chemicals (Canada) Ltd.

Plastics

AGRA Industries Limited
Canadian General Tower Limited

General Manufacturing

Tramrock EJC Canada Ltd.
Teknion Furniture Systems
VicWest Steel
Viskase Canada Inc.
Wabash Alloys Ontario
Woodbridge Group
Wyeth-Ayerst Canada Inc.
Westcast Industries Inc.

Minerals

Global Stone Corporation
Hillsborough Resources Limited

Mining

Hemlo Gold
Hillborough Resources Limited
Iron Ore Company of Canada
Mines et exploration Noranda Inc.
Noranda Metallurgy Inc.
Quebec Cartier Mining Company
Teck Corporation
INCO Limited
Westmin Resources Limited

Petroleum Refining

Parkland Refining Ltd.
Petro-Canada
Safety-Kleen
Shell Canada Limited
Suncor (Sunoco Group)
Syncrude Canada Ltd.
Ultramar Canada Inc.

Plastics

Husky Injection Molding Systems



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Appendix 3

Industrial Energy Innovators - By Sector

Pulp and Paper

Avenor Inc.
Canfor Corporation
Cascades Paperboard International
Donohue Inc.
Eurocan Pulp & Paper Co.
Lake Utopia Paper
MacMillan Bloedel Limited
Kruger Paper Inc.

Steel

Dofasco
IVACO Inc.
Slater Steels HSB Division
Stelco Inc.
Stelco Fasteners Ltd.
Stelco-McMaster Ltee

Textiles

Agmont Inc.
Albarrie Canada Limited
C.S. Brooks Canada Inc.
Canada Hair Cloth Co. Limited
Coats Bell
Coats Patons
Collingwood Fabrics
Collins & Aikman
Consoltex Inc.
de Ball Canada Inc. (J.L.)
Dominion Textiles Inc.
Fabrene Inc.

Transportation

Accuride Canada Inc.
Hawker Siddeley Canada Inc.
Altek Automotive Castings
CAMI Automotive Inc.
Chrysler Canada
Eaton Corporation
Ford Motor Company of Canada
Freightliner of Canada Ltd.
General Motors of Canada Ltd.

Pulp and Paper

Maritime Paper Products Limited
Quno Corporation
Rainy River Forest Products Inc.
Repap Enterprises Limited
St. Marys Paper Ltd.
Stora Forest Industries Limited
Weyerhaeuser Canada

Steel

Stenfil Ltée
Stelpipe Ltd.
Stelwire Ltd.
Sydney Steel Corporation
Welland Pipe Ltd.

Textiles

Glendale Yarns Inc
Glenelg Textiles Limited
LaGran Canada Inc.
Lincoln Fabrics Ltd.
Nova Scotia Textiles Limited
Peerless
The Britex Group
The Cambridge Towel Corporation
Union Felt Products Inc.
The Stewart Group Limited
Vagden Mills Limited
Vitafoam Products Canada Ltd.
Weavexx

Transportation

Kelsey Hayes Canada Ltd.
McDonnell Douglas Canada Ltd.
Navistar International Corporation
Orion Bus Industries Ltd.
Prevost Car Inc.
Rockwell International
Russell Metals
Toyota Motor Manufacturing Can.
Westcast Industries Inc.
Volvo Canada Ltd.



CIPEC

Appendix 4

Recording Industry's Progress

Government records industry's actions to reduce energy consumption and related greenhouse gas emissions through:

- the National Inventory of Greenhouse Gas Emissions
- the Climate Change Voluntary Challenge and Registry (VCR).

The National Inventory of Greenhouse Gas Emissions

The National Inventory of Greenhouse Gas Emissions is maintained by Pollution Data Branch, Environment Canada. Its first report, "Canada's Greenhouse Gas Emissions: Estimates for 1990", was issued in 1992.

This inventory of greenhouse gas emissions is the official record of all Canadian emissions and is used to make international comparisons and for monitoring Canada's 1992 Rio Accord commitment.

Efforts are underway to ensure that the database and methodology used by Environment Canada and those used by CIEEDAC, to determine GHG emissions, are compatible.

Climate Change Voluntary Challenge and Registry (VCR)

The Voluntary Challenge and Registry was established in 1995 by the federal and provincial governments as part of Canada's commitment to reduce energy use and to stabilize GHG emissions at 1990 levels by the year 2000.

The Minister of Natural Resources Canada is responsible for the VCR. It is designed to register tangible, voluntary commitments to achieve Canada's GHG stabilization goals.

There are four alternative ways a company can become registered in the VCR, including registering:

- directly with the VCR
- through CIPEC, as part of the industrial energy innovator program
- through its trade association, or
- a combination of the above.

The VCR is not an official record of industry's achievements rather it is a catalogue of actions which can be used, accessed on Internet and/or by the Minister of Natural Resources Canada to illustrate industry's commitment to the Voluntary Challenge.

Industrial Energy Innovators

The Industrial Energy Innovator (IEI) program is a joint initiative of CIPEC and Natural Resources Canada. It promotes the implementation of cost effective energy efficiency measures and related carbon dioxide emission reductions in a systematic fashion within the manufacturing or mining sectors.

Recording Industry's Progress

Industrial Energy Innovators

Registering as an Industrial Energy Innovator records the commitment of a manufacturing or mining company to implement energy efficiency measures that make good economic sense, to review energy efficiency performance at least annually, and to furnish a brief annual review of its successes and/or achievements using a special CIPEC form designed for this purpose.

An Industrial Energy Innovator receives a plaque, signed by the CIPEC Chairman and the Minister of Natural Resources Canada, in recognition of the company's leadership in improving energy efficiency and thereby helping Canada meet its commitment under the 1992 Rio Accord.

A company qualifying as an Industrial Energy Innovator can, at its request, be automatically registered as such in the VCR, but this does not require a company to report additional information to the VCR.

The Registration Process

The following describes and compares how a company can become registered with the VCR or as an Industrial Energy Innovator.

VCR

Letter of Intent

Direct to:

Sue Kirby
Senior Director
Voluntary Challenge and Registry Program
Natural Resources Canada
580 Booth Street
Ottawa, Ontario K1A 0E4

An organization submits a Letter of Intent to the Registry signed by the CEO:

- clearly indicating the organization's commitment to respond to the Challenge
- identifying in broad terms the types of activities being considered
- providing a time-frame for submitting the organization's action plan
- providing some indication of general goals or, ideally, a greenhouse gas (GHG) emission reduction target

Industrial Energy Innovator

Letter of Intent

Direct to:

Chuck Hantho
Chairman,
Canadian Industry Program for
Energy Conservation (CIPEC)
75 International Boulevard
Toronto, Ontario M9W 6L9

A manufacturing or mining company submits a letter confirming that it will:

- implement energy efficiency measures that make good economic sense
- review energy efficiency performance at least annually
- furnish a brief annual review of its successes and/or achievements using a special CIPEC form designed for this purpose



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Appendix 4

VCR Action Plan

An Action Plan should be submitted and provide information on net GHG emission reductions planned in the following main reporting categories:

- own emissions
- partnerships
- off-sets

The Action Plan should include:

- base level emissions or closely related proxies such as a base level of energy consumption by fuel types
- forecasts or projections of GHG emission levels
- goal(s), target(s) and/or objective(s) and time frames
- actions (measures to attain goals or objectives) Further Information
- commitment to continued development of plans and ongoing assessment

Progress Reports

They should be submitted annually to the Registry and include:

- a brief description of the ongoing objectives and methodology
- to the extent possible, calculated or measured results in terms of GHG emissions reductions and/or interim measures of progress such as changes in energy use, noting any variance from action plans previously submitted
- any new or revised actions planned; any new or revised goals or objectives

Further Information

Contact:
Nick McCartney
Voluntary Challenge and Registry Program
Natural Resources Canada
580 Booth Street
Ottawa, Ontario K1A 0E4
Telephone: (613) 996-6698
Fax: (613) 947-6799

Industrial Energy Innovator Action Plan

Six months after becoming an Industrial Energy Innovator, CIPEC will communicate with the company seeking information on progress being made in responding to its energy efficiency undertaking and, if possible, obtain a copy of the company's energy efficiency action plan screened to remove any sensitive or confidential information.

Progress Reports

This should be submitted annually and include a brief review of an Industrial Energy Innovator's successes and/or achievements in the energy efficiency area, utilizing a form furnished by CIPEC for this purpose.

Further Information

Bent Larsen
Executive Director
CIPEC
75 International Boulevard, 4th Floor
Toronto, Ontario M9W 6L9
Telephone: (416) 798-8155
Fax: (416) 798-9174

Letters of Cooperation (LOC's)

Over the past two years, CIPEC has entered into Letters of Cooperation (LOCs) with 15 associations and a number of individual companies.

The associations are:

Aluminum Industry Association	Automotive Parts Manufacturing Association
Canadian Chemical Producers' Association	Canadian Gas Association
Canadian Manufacturers' Association	Canadian Petroleum Products Institute
Canadian Plastics Institute	Canadian Steel Environmental Association
Canadian Pulp and Paper Association	Cement Council of Canada
Canadian Textile Institute	Mining Association of Canada
Electro Federation Canada	Motor Vehicle Manufacturers Association
Canadian Lime Institute	

The companies are:

McCain Foods Limited	Moosehead Breweries Limited
Molson Breweries	Labatt Breweries of Canada

Other LOCs are in process. Set out below is a sample Letter of Cooperation

"By this letter of cooperation, (LOC), the Association in collaboration with CIPEC, undertakes to encourage its member companies to develop and implement plans for energy efficiency as a means of becoming more competitive, thereby participating in helping to meet Canada's carbon dioxide emission stabilization goals.

The Association will work with its member companies to:

1. Appoint a CEO to the CIPEC Policy Board.
2. Establish an industry sector Task Force within CIPEC to develop sector targets and to develop plans to continually improve energy efficiency in relation to such targets.
3. Provide input to reports and studies prepared by or for CIPEC or government on sector energy efficiency improvement performance or potential.
4. Identify industry sector opportunities for the promotion of industrial energy efficiency, including training and technology.
5. Distribute CIPEC material supporting energy efficiency, as appropriate.
6. Support research activity aimed at improving the efficient use of energy.
7. Promote participation in the Industrial Energy Innovators initiative. (This is a recent addition).



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Appendix 5

Letters of Cooperation (LOC's)

CIPEC will provide:

1. Sector data on energy efficiency and/or other criteria mutually agreed upon by the sector Task Force and CIPEC.
2. Administrative support to the Task Force in response to its needs.
3. Public recognition of Industrial Energy Innovators as well as the Association for their leadership in improving energy efficiency.
4. Access to CIPEC support service, including Training, On-Site Human Resources, Sector Studies, Energy Efficiency related financing, Technology Development, and Task Force Marketing.
5. Promotion of the progress of industry sectors and industry-at-large in meeting the goals of CIPEC and Canada in terms of improving energy efficiency and helping to meet Canada's carbon dioxide emissions stabilization goals.
6. Communication linkages with government agencies and other related associations on energy efficiency matters.

Further, both parties recognize that: a) this voluntary agreement may be terminated at any time by either party, and b) as a participant, the Association shall be entitled to use the logo and other intellectual property of CIPEC in its promotion of industrial energy efficiency.

Accepted and agreed to this _____ day of _____, 1994

Chuck Hantho, Chair
Policy Board, CIPEC

Association Chair

For More Information about CIPEC and its activities, write, fax or call:

Bent Larsen, Executive Director
CIPEC Secretariat
4th Floor, 75 International Boulevard
Toronto, Ontario
M9W 6L9
Tel: (416) 798-8155
Fax: (416) 798-9174

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